ANNUAL REPORT 2009

SPIE
Student Chapter
V. Karazin Kharkiv National University

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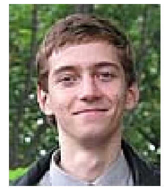

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Total Student Member: 5

ACTIVITY PLAN & FINANCIAL SUPPORT

1. *The contest of best paper in frame of the International Young Scientist Workshop on "Optics, Photonics and Metamaterials - 2009" Kharkiv, Ukraine, September 25-27, 2009, the 1st award - $100 (http://www.ysc-meta.org/pages/welcome).*

2. *The contest of best paper in frame of the International Young Scientist Workshop on "Optics, Photonics and Metamaterials - 2009" Kharkiv, Ukraine, September 25-27, 2009, the 2nd award - $50 (http://www.ysc-meta.org/pages/welcome).*

3. *IV Young Researcher Career Development Workshop IRE NASU, Kharkov, December 2009 - $250.*

4. *Participation in the schools and conferences on Optics & Photonics by V.Karazin KhNU chapter members (travel grants + conference fee) - $100.*

Total (SPIE funding received): $500

RECENT ACTIVITIES

International Young Scientist Workshop on "Optics, Photonics and Metamaterials - 2009"

Dates & Venue: November 25-27, 2009, Kharkiv National University of Radio Electronics, Kharkiv, Ukraine

http://www.ysc-meta.org/pages/welcome

THE CONTEST OF BEST PAPER

For the first time this year with OSA/SPIE IRE Chapter the OPAM Workshop was organized.

The objective of the workshop is to bring together experienced and young scientists working on various aspects of optics, photonics and metamaterials areas, to discuss the most recent developments in these areas. The workshop attracted participants from many different institutions from Ukraine, Belarus, Russia, Armenia, European Community and USA. Students have opportunity to present their research both oral and poster presentations.

During the workshop the following activities were held:

- Invited Talks (distinguished OSA/SPIE/IEEE lecturers)
- Young Scientists Talks
- OSA, SPIE and IEEE Ukrainian student chapters with collaboration with different Student Chapters around the world will organize a meeting for the leaders of OSA, SPIE and IEEE student chapters;
- Seminar with Representatives of Editorial Boards of Scientific Ukrainian Journals;
- Photography Contest Optical Image
- Excursion around Kharkov City

In the frame of this activity our chapter carried out contest on the Best paper presentation. The winners received a fee (1st award - $100, 2nd award - $50 & souvenir, 3rd award - $50) and an opportunity to participate in the 2nd International Scientific Conference "Electronic components base. The state and prospects of development" which was held on September 29, 2009 – October 3, 2009 on the territory of the Crimea.

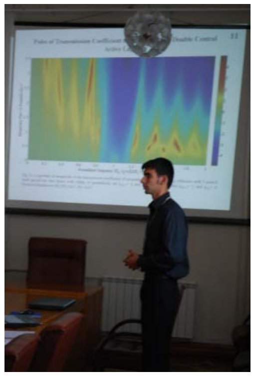
Total spent: $200

Amount requested: $150

WINNERS

The First Award:
Roman Noskov, Russia

The Second Award:
Dmitriy Sidorov, Ukraine



The Third Award:
Alexander Muravsky, Belorus

Images of pulse and moving sources produced by a planar left-handed superlens

R.E. Noskov [1], A.A. Zharov [1], N.A. Zharova [2]

[1] *Institute for Physics of Microstructures, Russian Academy of Sciences, Nizhny Novgorod 603950, Russia*
[2] *Institute of Applied Physics, Russian Academy of Sciences, Nizhny Novgorod 603600, Russia*
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A great deal of interest to the problem of optical sub-wavelength imaging is explained by many potential applications, including lithography and data storage on nanometer scales. The concept of a perfect lens (or superlens) [1] offers one of the potential ways for improving the resolution of imaging systems based on the unique properties of the so-called left-handed metamaterials (LHM) or materials with negative refractive index [2]. The possibility of a perfect lensing with the resolution which is not limited by the classical diffraction limit has been a subject of intense debates in scientific community in the recent years and, at first, was met with considerable opposition [3]. However, many questions raised by the critics have been answered [4, 5] through the results of realistic numerical simulations [6, 7] and experiments on negative refraction [8-10].

The so-called superlens is a slab of a LHM with $\varepsilon = \mu = -1$, where ε is the dielectric permittivity and μ is the magnetic permeability. Long ago, Veselago [2] predicted that such a material would have a negative refractive index of $n = -\sqrt{\varepsilon\mu} = -1$, and a flat slab of this material would act as a lens refocusing all rays from a point source on one side of the slab into a point on the other side of the slab. Much later, Pendry [1] showed that such a lens can reconstruct the near field of a source in the image plane that results in a perfect image [1].

A stationary lossless solution, indeed, gives the ideal image of a monochromatic source produced by a perfect lens independently of the source spatial spectrum. Formally this result can be explained by amplification of evanescent modes inside a left-handed slab. At the same time, using this solution may lead to some incorrect results and even paradoxes [11]. This is a typical situation for resonant systems and may be related to the different reasons, such as resonant excitation of eigenmodes accompanied with unrestricted growth of response or absence of any stationary solution. For the correct system description, in this case, one should make any regularization, for example, taking into account finite losses or nonstationarity of the process. For the perfect lens the resonant response takes place due to degeneration of the spectrum of surface waves at both interfaces of the left-handed slab which means simultaneous existence of surface waves with any polarization and any transversal wave numbers. Influence of energy dissipation in the lens within the framework of a stationary problem has been analyzed, for example, in [12]. The authors of this paper showed that even small losses leads to strong suppression of the transmitted wave spectrum, that leads to the fundamental resolution limit. However, spatiotemporal dynamics of subwavelength imaging is still quite obscure. In particular, for nonstationary sources this problem has not been discussed at all. Besides, it is important to discuss the role of resonantly excited surface waves in a slab of LHM in this process. The forming of images by the superlens in terms of a dynamical (for example, initial) problem has been considered basically by means of numerical simulations [6, 7].

In this report, we show that resonant excitation of the surface waves at interfaces of the left-handed slab by near fields of the external source are the key mechanism leading to the sub-wavelength imaging by the superlens. Our investigation is based on ‘the split-field method’ which, for the first time, was developed for the analysis of self-focusing low [13]. This approach enables to obtain the spatiotemporal structure of the electromagnetic field of the external source located nearby the left-handed slab in the whole space, allowing to find the fundamental resolution limits of the left-handed superlens for sources of different types. In particular, we consider the cases of pulse, moving with a constant speed and vibrating in space sources.

References

[1] J.B. Pendry, Phys. Rev. Lett. **85**, 3966 (2000).
[2] V.G. Veselago, Sov. Phys.—Usp. **10**, 569 (1968).
[3] N. Garcia N and M. Nieto-Vesperinas, Phys. Rev. Lett. **88**, 207403 (2002).
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[7] M.W. Feise, J.B. Schneider, and P.J. Bevelaoque, IEEE Trans. on Antennas and Propagation. **52**, 2955 (2004).
[8] A.N. Lagarkov and V.N. Kissel, Phys. Rev. Lett. **92**, 077401 (2004).
[9] A. Grbic and G.V. Eleftheriades, Phys. Rev. Lett. **92**, 117403 (2004).
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[11] J.J. Cui, Q. Cheng, W.B. Lu et al., Phys. Rev B **71**, 045114 (2005).
[12] V.A. Podolsky and E.E. Narimanov, Opt. Lett. **30**, 75 (2005).
[13] A.I. Smirnov and G.M. Fraynman, JETP **54**, 737 (1982), (*in Russian*).

Resonance Properties of Quasiperiodic One-dimensional Photonic Crystals with Metamaterial Layers

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Purpose

Periodic layered structures (one-dimensional photonic crystals) widely used in engineering [1]. Resonance phenomena become more complicated and interesting in cases of distortion of periodicity [2, 3]. Some types of this distortion modify properties of Bragg reflection [2] and other ones transform structure into resonator with high Q-factor [3] that can be applied in lasing devices. It is important to investigate properties of one-dimensional photonic crystals as reflector and resonator for different shapes of magnitude and phase perturbations. Additional enrichment of physical effects can be achieved by introduction into structure layers of metamaterials with negative parameters [4].

Methods

If incident wave is plane and monochromatic, and medium parameters are step functions of longitudinal coordinate, exact solution for amplitudes of reflected and transmitted waves can be found by method of transmission matrices [1-4]. In the presented work this method was modified for cases of loss or gain and metamaterials with negative parameters. The complex frequencies of eigenmodes were found by computation of poles of elements of scattering matrix in domain of complex frequency. Transmission coefficients are more suitable because they contain only complex poles without complex zeros. Initial values of frequencies and threshold of lasing were determined by map construction of inverse values of magnitude of transmission coefficient. After that they were improved by Newton method.

Results

Two type of “brewsterization” of Bragg resonance is observed in periodic layered structure when reflection is absent even at satisfaction of resonance condition. The first type takes place when incident angle is equal to Brewster angle on all interfaces of layers. It depends on relations between permittivity and permeability of layers and does not depend on their thickness. The second type is caused by coincidence of condition of Bragg resonance and condition of resonance passage through each layer. It depends also on thickness of layers. For example at normal incidence each ($m+l$)-th Bragg reflection is absent if ratio of electrical thicknesses of layers is equal to rational number m/l. At oblique incidence appearance of “brewsterization” depends on ratio of phase shifts in layers.

Influence of negativity of permittivity and/or permeability of one of two layers consisting period of structure was investigated. If only one parameter is negative and corresponding layer is thick, Bragg structure transforms into chain of high-Q resonators with narrow bands of passage. If layer with negative value of permittivity or permeability is thin, structure has narrow bands of reflections. Bragg structures containing metamaterial with both negative parameters, permittivity and permeability provide focusing of reflected and transmitted wave beams, if electrical thickness of layer of metamaterial more than electrical thickness of layer of ordinary dielectric.

The phenomena of brewsterisation of Bragg reflection in structures containing metamaterial have special features because in this case electrical thickness of period is equal to difference of electrical thicknesses of layers of dielectric and metamaterial. At normal incidence each ($m+1$)-th Bragg reflection is absent if ratio of electrical thicknesses of layers q is equal to $m+2$ or $1/(m+2)$ (m is natural number). If value $q=2$ or $q=1/2$ all Bragg bands vanish. If layers of metamaterial and dielectric have the same electrical thicknesses ($q=1$), Bragg reflection stops to be resonant, it is observed on almost all frequencies excepting narrow bands of resonance passage through one layer.

Investigations of complex eigenfrequencies of eigenmodes and frequencies and threshold of lasing in resonators with quasiperiodic Bragg reflectors have showed, that smoothing of the perturbation magnitude allows increasing imaginary part of eigenfrequencies (decreasing Q-factor) and reduction of threshold of unwanted oscillations.

References

[1] Elachi C, 1976 *Proceedings of the IEEE* **64** 1666
[2] Barriuso A G, Monzon J J, and Sanchez-Soto L L, Felipe A 2005 *Opt. Express* **13**, 3913
[3] Byelobrov V O and Nosich A I 2007 *Opt. Quant. Electron.* **39** 927
[4] Caloz C., Itoh T. 2006 *Electromagnetic Metamaterials Transmission Line Theory and Microwave Applications* (John Wiley & Sons, Inc., NJ: Hoboken) p 352

Patterned rubbing liquid crystal alignment technique for fabrication of photonic devices

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The practical implementation of any photonic device requires solving the fabrication problem. Application of standard photolithographic approaches developed in microelectronics for formation of volume shapes often results in no or low yield due to the extreme levels of complexity of theoretical designs with many masking steps multi-layered structures. Meanwhile, the often aim is just to create the predefined distribution of refractive index in the layer on a substrate. The latter is performed inside every liquid crystal (LC) display in between two thin film polarizers to control the intensity of transmitted light. On the one hand, liquid crystal material allows to create sophisticated distribution of refractive index and to maintain it during device operation. On the other hand, LC display operation requires constant voltage application to pixels electrode to achieve permanent index distribution, while the pixilated structure has non-switchable interpixel regions, which induce poorly predictable diffraction and scattering losses in photonic device applications, such as liquid crystal waveguides, cladding, interfaces and etc.

Patterned alignment of liquid crystal allows to refuse from constant voltage application removing the non-switchable LC regions, while the possibility to achieve refractive index distribution in LC layer remains available. Patterned LC alignment is realized with the help of the photosensitive alignment material, which maintains the photoinduced surface anisotropy to orient liquid crystal. Alignment pattern is transferred from a photomask in masking exposure process, while the direction of orientation is the subject to aligning treatment. The most reliable and well developed aligning treatment is rubbing of alignment layer surface with cloth. Rubbing is the standard process implemented at every LCD fabrication facility, which gives high quality uniform alignment of liquid crystal. Nevertheless, patterned alignment by rubbing aligning treatment is not known.

The traditional way to create patterned LC alignment surface is the photoalignment process [1]. Photoalignment uses polarized light to form the photoinduced surface anisotropy along or perpendicular to the polarization of exposure. Implementation of photoalignment in production is rather complex, as it requires large area polarized light exposure. The latter means expensive UV polarizers, polarization maintaining optical elements and special design of high-resolution photomask patterns that avoid depolarization of transmitted light. Besides for photoalignment surfaces the merit of the ability to orient liquid crystals in-plane, or the azimuthal anchoring energy, is typically 10^{-5}J/m^2, which is at least one order weaker than the typical values reported for rubbing process, above 10^{-4}J/m^2.

Our group is experienced in development of novel LC alignment materials and processes for new applications of liquid crystals in flexible display and photonics. We have developed the new process of patterned rubbing LC alignment (Fig.1), which is based on modification of B15 alignment material for plastic substrates [2]. The 1st layer of B15 material is deposited on the substrate, rubbed along the 1st direction and exposed with non-polarized light. Then the 2nd layer is deposited on top of the 1st layer and rubbed along the 2nd direction. Next the substrate is exposed with non-polarized light through a photomask to transfer the pattern. The unexposed material is developed in organic solvent forming the patterned alignment surface, which orients LC forming predefined distribution of refractive index (Fig.2).

The patterned rubbing process allows formation of patterned LC alignment using standard rubbing liquid crystal alignment technique. And, unlike photoalignment process, it utilizes non-polarized light, which simplifies and speeds-up fabrication. LC is aligned with strong azimuthal anchoring energy of >10^{-4}J/m^2.

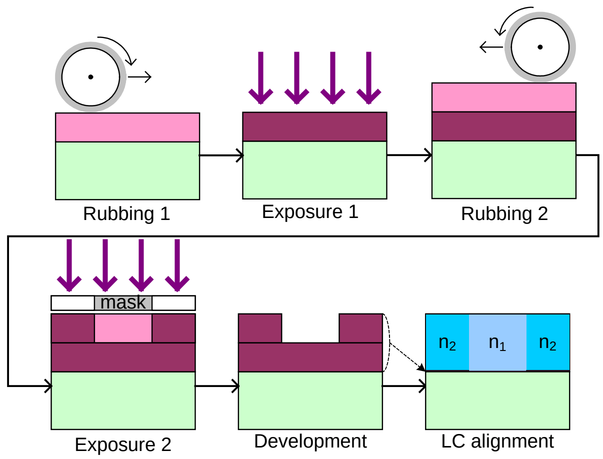

Figure 1. The process flow of patterned rubbing LC alignment process.

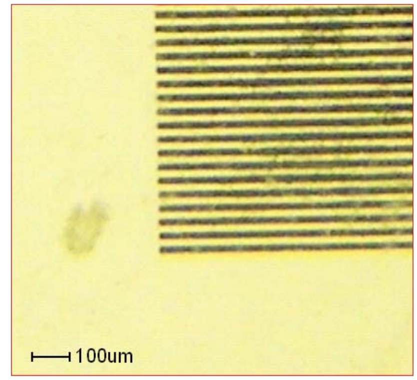

Figure 2. Microscopic picture of patterned LC structure (20um line) in between crossed polarizers: LC is along polarizers (dark area) and at 45degree to polarizers (bright area)

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[15] U.V. Mahilny, A.I. Stankevich, A.A. Muravsky, A.A. Murauski, Novel Polymer as Liquid Crystal Alignment Material for Plastic Substrates, J. Phys. D: Appl.Phys. **42**, 075303 (2009).

RECENT ACTIVITIES

International Young Scientist Workshop on "Optics, Photonics and Metamaterials - 2009"

Dates & Venue: November 25-27, 2009, Kharkiv National University of Radio Electronics, Kharkiv, Ukraine

http://www.ysc-meta.org/pages/welcome

Dr. Pavel Belov,
SPIE VISITING LECTURER,
EPSRC Advanced Research Fellow,
Dept. of Electronics and Engineering,
Queen Mary University of London,
United Kingdom

"Manipulations with near-field using metamaterials", "Metamaterials in optics", "Metamaterials overview"

KhNU SPIE Chapter participated in organizing the International Young Scientist Workshop on "Optics, Photonics and Metamaterials – 2009". As part of this event was the speech of SPIE Visiting lecturer Dr. Pavel Belov. There were discussed the following topics: metamaterials, plasomic nanostructures, photonic and electromagnetic crystals, impedance surfaces. His lectures attracted the attention of many participants (students, PhD students, young scientist etc.).

RECENT ACTIVITIES

IV Young Researcher Career Development Workshop (YRCDW'09)

Dates & Venue: December 2, 2009, Usikov Institute of Radiophysics and Electronics NASU, Kharkiv, Ukraine

http://www.ysc.org.ua

In frame of IX Kharkiv Young Scientist Conference on Electromagnetics, Photonics and Biophysics the IV YRCDW'09 "Bridging the gap between education and career in electromagnetic and photonics" was organized. YRCDW was a day-long event focusing on helping students who are in the early stages of their academic careers in electromagnetics and photonics. The workshop has also become a social phenomenon that helped participants to get to know each other, network with their peers and mentors and share ideas. The organizers hope that the workshop preceding it helped them not only to better integrate themselves into the main event but also to start their own social network and to gain useful insights in their future career opportunities.

During YSC-2009 and YRCDW'09 were an organized special coffee-breaks with light food and drinks. The foods and drinks were free for all the participants of the conference!

Equipment (rent of conference hall, laptops, LCD projectors) for IV YRCDW'09 and Special SPIE Coffee Break at the hotel "Aurora" for December 2, 2009: $200

Thanks to SPIE for support of our activities! ;-)






IX Kharkiv Young Scientist Conference "Electromagnetics, Photonics and Biophysics", 1-3 December 2009

IV Young Researcher Career Development Workshop

«bridging a gap between education and career in photonics and electromagnetics»

organized in the frame of YSC-2009, Kharkiv, Ukraine

*Date&Venue: **Wednesday, December 2, 2009, State Research and Design Institute of Basic Chemistry (NIOCHIM)***

Organized by :

IEEE Student Branch "IRE-KHARKIV"

Joint OSA/SPIE Student Chapter of Institute of Radiophysics and Electronics NAS Ukraine

MTT-S Student Chapter "IRE-KHARKIV-MTT"

AP/MTT/ED/AES/GRS/NPS/EMB Societies East Ukraine Joint Chapter

Joint OSA/SPIE Student Chapter of V. Karazin Kharkiv National University

National Technical University of Ukraine SPIE Chapter

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OSA Advancing the Science of Light

SPIE Connecting minds. Advancing light.

IEEE

Program of the Event

9:15 – 10:45 Session I: ***Lectures on electromagnetics and photonics of IEEE MTT and SPIE Visiting lecturers***

WAVEGUIDE FILTERS FOR SATELLITES
Prof. V. E. Boria, *Institute for Telecom. and Multimedia Applications, Technical University of Valencia, Valencia, Spain*

ELECTRODYNAMICS OF CARBON NANOTUBES AND CARBON NANOTUBE ARRAYS
Prof. I. S. Nefedov, *Department of Radio Science and Engineering, Helsinki University of Technology, Finland*

11:00 – 13:00 Session II: ***Societies benefits***

IEEE BENEFITS FOR STUDENTS

SPIE BENEFITS FOR STUDENTS

OSA BENEFITS FOR STUDENTS

PRESENTATION OF OSA/SPIE/IEEE STUDENT CHAPTERS *in the format of "Round table"*

13:00 – 15:00 ***Lunch***

15:00 – 17:00 Session III: ***Career Development Masterclass***

THE CRAFT OF SCIENTIFIC PRESENTATIONS: A LECTURE ON TECHNICAL PRESENTATIONS
Prof. V. E. Boria, *Institute for Telecom. and Multimedia Applications, Technical University of Valencia, Valencia, Spain*

AN OVERVIEW OF EUROPEAN COOPERATION ON ANTENNA RESEARCH
Dr. Marta Martínez-Vázquez, *Department of Antennas & EM Modelling, IMST GmbH, Germany*

www.ysc.org.ua xxv

IX Kharkiv Young Scientist Conference "Electromagnetics, Photonics and Biophysics", 1-3 December 2009

WAVEGUIDE FILTERS FOR SATELLITES

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An overview of all-metal waveguide filters for satellite payloads is offered in this talk [1]. Initially, an historical evolution of this filtering technology, including typical electrical and mechanical requirements, is outlined. Next, recent advancements in full-wave analysis methods and automated design procedures of these filters are reviewed. Then, a Computer-Aided Design (CAD) tool based on such techniques (i.e. FEST3D "Full-Wave Electromagnetic Software Tool for 3D Waveguide Components") is introduced, and its practical application to the analysis and design of several examples of satellite filters is presented. In particular, direct-coupled rectangular waveguide filters, E-plane waveguide technology, dual-mode filtering prototypes and evanescent mode waveguide filters are considered. Classical topologies, as well as more novel configurations for each filter class, are discussed.

[1] Vicente E. Boria and Benito Gimeno, "Waveguide Filters for Satellites," *IEEE Microwave Magazine*, vol. 8, no. 5, pp. 60-70, Oct. 2007.

THE CRAFT OF SCIENTIFIC PRESENTATIONS: A LECTURE ON TECHNICAL PRESENTATIONS

V. E. Boria

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This course provides attendees with an overview of what distinguishes the best scientific presentations. The course introduces a new design for presentation slides that is both more memorable and persuasive from what is typically shown at conferences. After completing this course, attendees will be able to:

- account for the audience, purpose, and occasion in a presentation/poster;
- logically structure the introduction, middle, and ending of a scientific presentation/poster;
- create a memorable and persuasive set of presentation slides;
- deliver a presentation/poster with more confidence.

This material is intended for anyone who needs to present scientific research. Those who either have not yet presented or have made several presentations/posters will find this lecture valuable.

IX Kharkiv Young Scientist Conference "Electromagnetics, Photonics and Biophysics", 1-3 December 2009

ELECTRODYNAMICS OF CARBON NANOTUBES AND CARBON NANOTUBE ARRAYS

I. S. Nefedov

Department of Radio Science and Engineering /SMARAD Center of Excellence
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This lecture is devoted to electrodynamical properties of carbon nanotubes. Carbon nanotubes are obtained by rolling graphene sheets. Depending how the graphene sheet is rolled, carbon nanotubes can possess semiconductor or metallic properties. Carbon nanotubes (CNs) can consist of one shell (single-wall CNs) or several shells (multi-walled CNs). We restrict our consideration by single-wall metallic nanotubes as better studied and possessing lower losses. Carbon nanotubes exhibit such electrophysical properties, caused by their quantum nature, as the quantum resistance, the quantum capacitance and the kinetic inductance. Transmission line model of the CN [1] includes these parameters in addition to macroscopic electromagnetic capacitance and electromagnetic inductance.

High-frequency properties of single-wall metallic CNs are caused by frequency-dependent complex conductivity. It is known, that in single-wall metallic CNs can propagate strongly delayed surface waves (with the slow-wave factor $n = \beta/k \sim 30 - 100$, where β is the propagation constant and k is the wave number in free space) [2]. New properties, caused by electromagnetic interaction between nanotubes, were found in structures, composed of closely packed bundles of parallel identical metallic CNs [3], and in two-dimensional periodic arrays of CNs. Our electrodynamical description of the CN array is based on Green's function formulation. As a model of the metallic nanotube, we take impedance cylinder, characterized by the complex dynamic conductivity. We have found, that a slow-wave factor of eigenwaves in infinitely long arrays of nanotubes strongly depends on a transversal wave vector and it varies from unit to more than 200, that is considerably higher than observed in single nanotubes. Arrays of metallic CNs look similar to wire media (WM). Common properties and differences between WM and CN arrays are discussed.

Surface waves in finite-thickness slabs of CN arrays were investigated. It was found, that backward waves can propagate in a very wide frequency range. Thus, such CN array slabs can be considered as perfect planar metamaterials. Influence of a dielectric substrate and possible tunability is considered. Losses at gigahertz and terahertz frequencies are analyzed. Possible applications as slow-wave structures and other tunable devices at terahertz frequencies are discussed.

[2] P. J. Burke, "An rf circuit model for carbon nanotubes," *IEEE Transactions on Nanotechnology*, vol. 2, no. 1, p. 5, March 2003.
[3] Slepyan, S. A. Maksimenko, A. Lakhtakia, O. Yevtushenko and A. V. Gusakov, "Electrodynamics of carbon nanotubes: Dynamic conductivity, impedance boundary conditions, and surface wave propagation," *Phys. Rev. B*, vol. 60, p. 17136, Dec. 1999.
[4] M. V. Shuba, S. A. Maksimenko, A. Lakhtakia, "Electromagnetic wave propagation in an almost circular bundle of closely packed metallic carbon nanotubes," *Phys. Rev. B*, vol. 76, p. 155497, 2007.

IX Kharkiv Young Scientist Conference "Electromagnetics, Photonics and Biophysics", 1-3 December 2009

AN OVERVIEW OF EUROPEAN COOPERATION ON ANTENNA RESEARCH

Marta Martínez-Vázquez

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Antenna research has a long tradition in Europe, although the efforts have been often scattered and uncoordinated, with a large gap between university research and industrial applications. A first step towards collaborative research was made with the creation of the COST activities, also referred to as an Action ("CO-operation in the field of Scientific and Technological research"), sponsored by the European Commission. Under the COST umbrella, different Actions were approved since the early 1970s that deal with antenna R&D. From the first COST Action 25/1 ("Aerial Networks with Phase Control", 1973-1979) to the recently started COST IC 0603 Action ("Antenna Systems & Sensors for Information Society Technologies", 2007-2011), the number of signatory countries has increased from 5 to over 20. These COST Actions have allowed the exchange of know-how in a non-competitive manner, and are still an excellent forum for open discussion regarding blue sky research. They have also fostered collaborations between European organizations and the mobility of researchers, especially young PhD students, through short term missions, for example. Being essentially an open forum at a pre-competitive level, COST is the ideal complement for other joint European research programs, and many innovative concepts and novel antenna designs have their roots in COST meetings. Within the 6th Framework Program of the European Commission, a new structuring instrument was used to complement and enhance the collaboration initiated within COST, and thus further coordinate antenna research to deal with the new challenges of the 21st century: The Antenna Centre of Excellence (ACE) was established as a Network of Excellence, including over 50 European institutions, both industrial and academic from 17 European countries, with over 300 researchers and 130 PhD students, and over 100 external participants from around the world as members of the "ACE Community". Over 4 years, ACE has tried to structure the fragmented European antenna R&D world, reduce duplications and boost excellence and competitiveness in key areas. Some of the results of ACE are:

- The creation of the European School of Antennas, a new system of geographically distributed PhD school which aims to improve the antenna advanced training and research in Europe;
- Cooperation in antenna measurement, with an on-line database of measurement facilities and collaboration agreements;
- Benchmarking of measurement facilities and software tools;
- The development of the EDI (Electromagnetic Data Interface) for the exchange of compatible data between different software tools;
- The creation of EuCAP (European Conference on Antennas and Propagation), EurAAP (European Association on Antennas And Propagation) and many new research groupings in critical areas;
- The Virtual Centre of Excellence, a multimedia platform designed to provide a set of added value services to this Community by establishing a single point (website based) to share information across the entire research-manufacturing-users chain.

RECENT ACTIVITIES

Participation in the schools and conferences on Optics&Photonics, 2008-2009

Oleksii Galan,
26-30 October 2009,
Chalmers University of Technology,
Gothenburg, Sweden




European School of Antennas, the short course "Artificial EBG surfaces and metamaterials for antennas"

Oleksii Galan attended the European School of Antennas, the short course “Artificial EBG surfaces and metamaterials for antennas”, Chalmers Univ. of Technology, Gothenburg, Sweden, 26-30 October 2009.

Travel grant: $70

European School of Antennas

Certificate
of participation
in the short course

Artificial EBG surfaces and metamaterials for antennas:
Bandgaps, cloaking, gap waveguides, packaging,
miniaturization, gain enhancement, sidelobe reduction

Aleksey Galan

The short course was arranged 26-30 October 2009 by Professor Per-Simon Kildal at Chalmers University of Technology.
The course was completed by a written exam the week thereafter, from the candidates home location, which he passed.
The recommended number of ECTU course points is 2.

CHALMERS


Thanks to support of SPIE! ;-)

Olga Zherobkina,
25-27 November 2008,
IRE NASU,
Kharkiv, Ukraine

VIII Kharkiv Young Scientist Conference on "Radiophysics and Electronics, Biophysics", IRE-YSC 2008

Olga Zherobkina presented a conference paper "Electromagnetic impulse interaction with biological tissues on the flatlayered dielectric as example" , VIII Kharkiv YSC on "Radiophysics and Electronics, Biophysics", IRE NASU, Kharkiv, Ukraine.

Conference fee: $30

Thanks to support of SPIE! ;-)

Total spent: $100

Amount requested: $100

FINANSIAL REPORT

	Amount, USD	Description
1	100	The contest of best paper in frame of the International Young Scientist Workshop on "Optics, Photonics and Metamaterials - 2009" Kharkiv, Ukraine, September 25-27, 2009, the 1st award
2	50	The contest of best paper in frame of the International Young Scientist Workshop on "Optics, Photonics and Metamaterials - 2009" Kharkiv, Ukraine, September 25-27, 2009, the 2nd award
3	50	The contest of best paper in frame of the International Young Scientist Workshop on "Optics, Photonics and Metamaterials - 2009" Kharkiv, Ukraine, September 25-27, 2009, the 3rd award
4	200	IV Young Researcher Career Development Workshop IRE NASU, Kharkov, December 2009
5	100	Participation in the schools and conferences on Optics & Photonics by V.Karazin KhNU chapter members (travel grants + conference fee)

Total spent: $500

Amount requested: $500

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