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Report

75th IUVSTA WORKSHOP ON SHEATH PHENOMENA IN PLASMA PROCESSING OF ADVANCED MATERIALS (Cerklje na Gorenjskem, Slovenia, 19th – 23rd January 2015)

The workshop was organized in a remote Hotel Krvavec in Slovenian mountains not far from Ljubljana International airport. The Workshop was proposed jointly by Plasma Science & Technique and Electronic Materials & Processing Divisions of the International Union for Vacuum Science, Techniques and Applications, and approved at the 119th IUVSTA Executive Council Meeting, Dubrovnik, Croatia, 12th October 2014.

The aim of this specialized workshop was to discuss open questions in behaviour of plasma species in the sheath between plasma and solid or liquid materials. The workshop brought together worldwide renowned leading scientists in this scientific niche. The names of speakers are revealed from attached conference schedule. The invited speakers were selected carefully to cover specific approaches of leading research groups. Both theoreticians and experimentalists joined the Workshop. They presented recent development and details in behaviour of charged and neutral reactive particles as well as dust in sheath next to solid materials. The speakers presented simulation of sheath development and interaction of charged particles with electromagnetic fields, detection and measurements of particles within the sheath, collision phenomena and heating of electrons, behaviour of dust particles within the sheath, and synthesis as well as modification of advanced nanostructured materials suitable for application in electronics as well as biomedicine.

Invited speakers came from France, Germany, Ireland, Japan, Portugal, Romania, Singapore, Slovenia, Spain, Taiwan, UK and USA. The list is presented in the attached table. The schedule was concentrated to 5 days and is presented in the attached table. Ample time was dedicated to formal as well as informal discussions. Formal discussion was organized as topical round tables in four sessions (see attached table) while isolation of the hotel allowed informal discussions. The general conclusion that could be extracted from the discussions is that the knowledge about sheath phenomena has definitely improved in the last few years due to introduction of novel experimental techniques as well as advanced simulation codes. The sheaths are particularly important for plasmas created at atmospheric pressure when they are allowed to interact with biological materials. In such cases the research is still in infancy and the complex interactions do not allow for detailed understanding of the exact mechanisms that cause observed effects.

The IUVSTA grant of 6.000 Euro was gratefully acknowledged and was spent to subsidize a part of invited speakers' expenses, as well as to cover general organization costs.

Ljubljana, 19th February 2015

Workshop president
Prof. Dr. Miran Mozetič

Attachment: the workshop schedule, some photos



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SLOVENIAN SOCIETY FOR VACUUM TECHNIQUE

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The 75th IUVESTA Workshop on Sheath Phenomena in Plasma Processing of Advanced Materials (19th-23rd 2015, Slovenia)

Mon. 19. Jan			
13.00 - 19.00	Arrivals		
19.00 - 20.00	Dinner		
20.00 - 20.20	Opening	M. Mozetič (SLO) ; Motivation for sheath phenomena studies	miran.mozetic@ijs.si
20.20 - 20.50	INV	T. Gans (UK) ; Tailoring the plasma-surface boundary sheath interface using non-linear frequency coupling	timo.gans@york.ac.uk
20.50 - 23.00	Welcome reception		

Tue. 20. Jan			
8.50 - 9.00	Introduction	U. Cvelbar (SLO) , M. Mozetič (SLO)	
9.00 - 10:30	Topical discussions	Measurements and plasma sheaths, lead by U. Cvelbar (SLO)	uros.cvelbar@ijs.si
10.30 - 11.00	Break		
11.00 - 12:30	Topical discussions	Measurements and plasma sheaths 2, lead by H. Kersten (GER)	-
13.00 - 14.15	Lunch		
14.30 - 15.00	INV	J. Kim (JPN) ; Sheath structure in a surface wave plasma reactor	jaeho.kim@aist.go.jp
15.00 - 15.30	INV	M. Turner (IRE) ; Electron heating in capacitive sheaths excited by complex wave forms	miles.turner@dcu.ie
15.30 - 16.00	INV	S. Nunomura (JPN) ; Real-time monitoring of a defect-rich surface layer during plasma processing	s.nunomura@aist.go.jp
16.00 - 16.30	Break		
16.30 - 17.00	INV	D. O'Connell (UK) ; Sheath dynamics in reactive atmospheric pressure plasmas	deborah.oconnell@york.ac.uk
17.00 - 17.30	INV	E. Kovačević (FRA) ; Synthesis and functionalization of advanced carbons by means of low temperature plasmas	eva.kovacevic@univ-orleans.fr
17.30 - 17.50	Regular	Y. Torigoe (JPN) ; Realization of highly stable a-Si:H film by using cluster eliminating filter	y.torigoe@plasma.ed.kyushu-u.ac.jp



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17.50 - 18.10	Regular	I. Junkar (SLO) ; Stability of titanium dioxide nanotube structure for medical applications ita.junkar@ijs.si
19.00 - 20.00	Dinner	
20.00 - 22.00	Posters	

Wen. 21. Jan			
8.00 - 12.30	Activities		
12.30 - 14.00	Lunch		
14.00 - 14.30	INV	A. Rousseau (FRA); Physics of the propagation in a dielectric tube, in the open air, and interaction of the plasma with a water surface	antoine.rousseau@lpp.polytechnique.fr
14.30 - 15.00	INV	C.C. Hsu (TWN); Recent Progress in the Development of Portable Microplasma Generation Devices – A New Route?	chsu@ntu.edu.tw
15.30 - 16.00	INV	J. Walsh (UK); Optimisation of air plasma discharges for microbiological decontamination	jlwalsh@Liverpool.ac.uk
16.00 - 16.30	INV	V. Guerra (PT); Self-consistent model of microwave micro-plasmas in dry air	vguerra@tecnico.ulisboa.pt
16.30 - 17:00	Break		
17.00 - 17.30	INV	C. Canal (SPA); Plasma polymerization to design advanced titanium dental implants	cristina.canal@upc.edu
17.30 - 18.00	INV	R. S. Rawat (SIN); Applications of High Energy Density Plasmas from Plasma Focus for Novel Material Processing and Synthesis	rajdeep.rawat@nie.edu.sg
18:00 - 18:30	INV	M. Godec (SLO); Carbides Transformation Phenomena in AISI M42 Steel: Bulk and Surface Effect	Matjaz.Godec@imt.si
19.00 - 20.00	Dinner		
20.00 - 23.00	Social program		

Thu. Jan 22			
9.00 - 10:30	Topical discussions	Plasma sheaths: electrical fields, lead by M. Mozetič (SLO)	miran.mozetic@ijs.si
10.30 - 11.00	Break		
11.00 - 12:30	Topical discussions	Plasma sheaths: charged particles, lead by M. Mozetič (SLO)	-



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13.00 - 14.15	Lunch		
14.30 - 15.00	INV	M. Hori (JPN); Etching of SiOCH in direct current superposed dual-frequency capacitively coupled plasmas with a sheath modification	hori@nuee.nagoya-u.ac.jp
15.00 - 15.30	INV	T. Kaneko (JPN); Physical and chemical effects of non-equilibrium plasma irradiation on enhancement of transfection efficiency	kaneko@ecei.tohoku.ac.jp
15.30 - 16.00	INV	H. Kersten (GER); Non-conventional diagnostics for process plasmas related to thin film deposition	kersten@physik.uni-kiel.de
16.00 - 16.30	INV	T. Ohta (JPN); Novel surface-assisted laser desorption/ionization method using carbon nanowalls for mass spectrometry	tohta@meijo-u.ac.jp
16.30 - 17.00	Break		
17.00 - 17.30	INV	H. Kondo (JPN); Selective and oriented growth of carbon nanowalls by plasma-enhanced chemical vapor deposition	hkondo@nagoya-u.jp
17.30 - 18.00	INV	K. Koga (JPN); Temporal development of nonlinear coupling between radicals and nanoparticles in reactive plasmas	koga@ed.kyushu-u.ac.jp
18.00 - 18.30	INV	G. Dinescu (ROM); Growth of particles in plasma at low and atmospheric pressure starting from metallic targets	dinescug@infim.ro
19.00 - 20.00	Dinner		
20.00 - 22.00	Round table on future research		
Fri. Jan. 23			
9.00 - 10:30	Topical discussions	Plasma sheaths for surface processing, lead by M. Hori (JPN)	-
10.30 - 11.00	Break		
11.00 - 12:30	Topical discussions	Neutral particles sheaths, lead by M. Mozetič (SLO)	-
12.30 - 14.00	Lunch		
14.00 -	Departures		



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Some attendees in the lecture room. From left to right: Martina Modic (Liverpool), James Walsh (Liverpool), Matic Resnik (Ljubljana), Nina Recek (Ljubljana), Matjaz Godec (Ljubljana), Hiroki Kondo (Nagoya), Christina Canal (Barcelona), Deborah O'Connor (York), Antoine Rousseau (Paris), Jaeho Kim (Tsukuba), Gheorghe Dinescu (Bucharest), Vasco Guerra (Lisabon), Masaru Hori (Nagoya), Miran Mozetic (Ljubljana), Rajdeep Singh Rawat (Singapore), Uros Cvelbar (Ljubljana), ChengChe Hsu (Taipei), Kersten Holger (Kiel), Toshihiro Kaneko (Sendai), Miles Turner (Dublin), Takayuki Ohta (Meijo), Yoshihiro Torigoe (Fukuoka), Kazunori Koga (Fukuoka) and Shota Nunomura (Tsukuba)

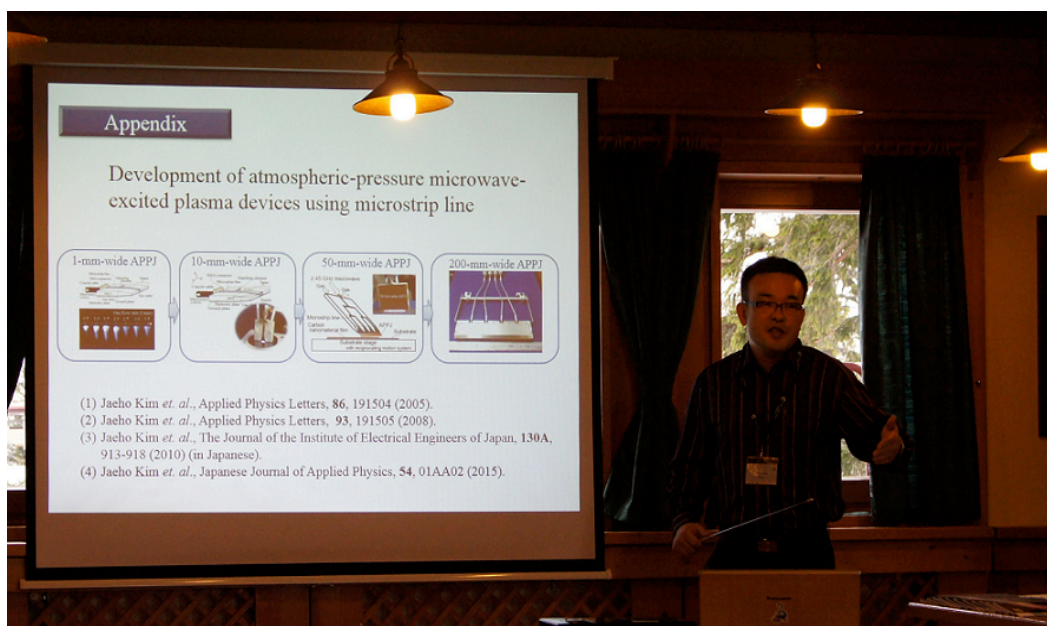


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Chair of IUVESTA Plasma Division, Prof. Timo Gans, was the first invited speaker.

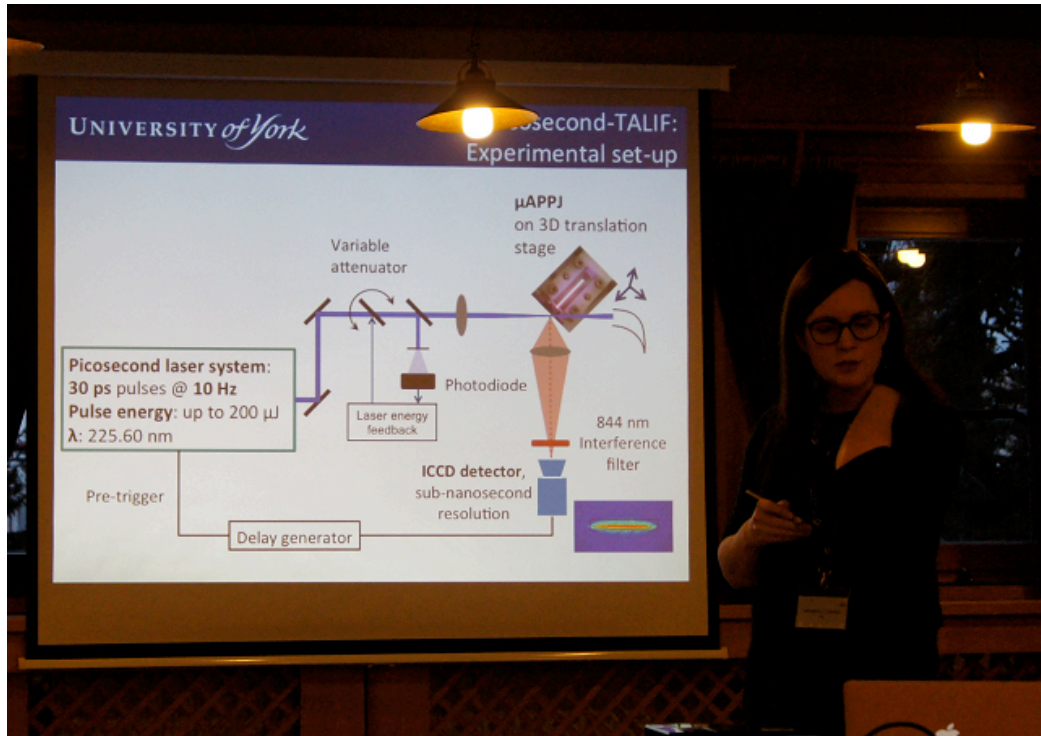


Prof. Jaeho Kim presented sheath peculiarities in surface-wave plasmas



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Prof. Deborah O'Connor, York University, spoke about sheath characterization

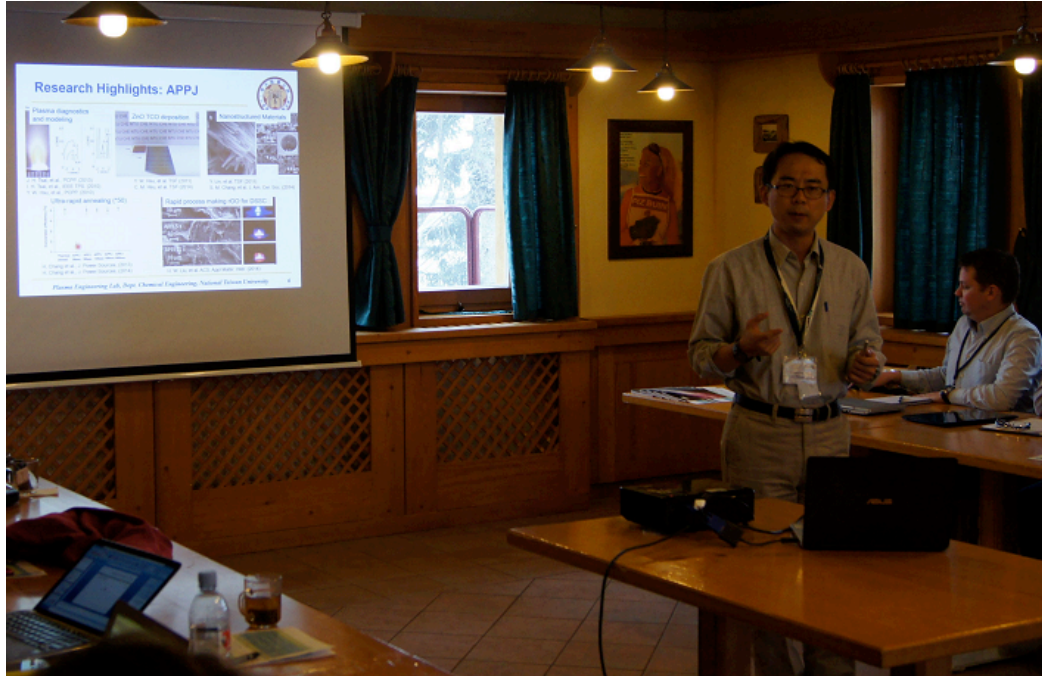


Prof. Antoine Rousseau from Paris presented an original characterization method

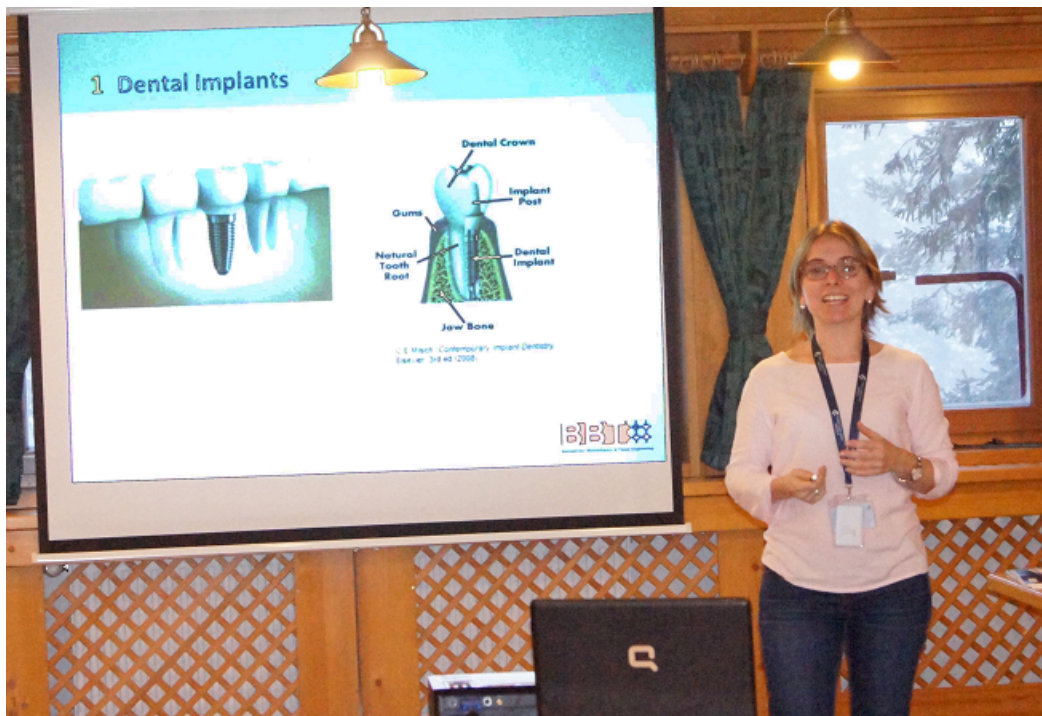


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Prof. ChengChe Hsu from Taiwan presented research highlights in atmospheric jets



Prof. Cristina Canal from Barcelona spoke about sheets next to dental implants



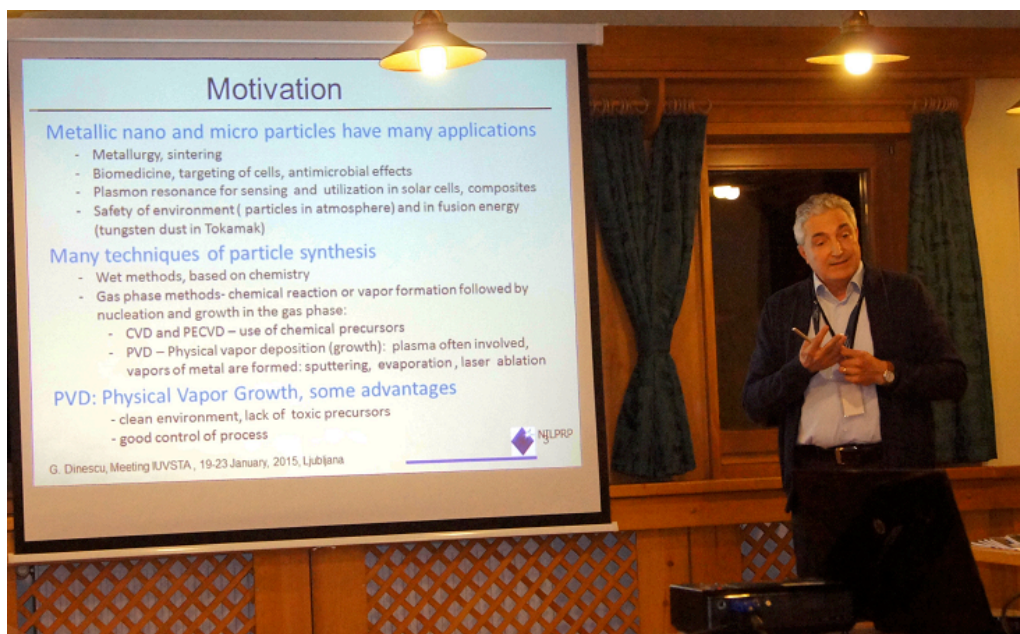
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Prof. Hiroki Kondo from Nagoya presented recent development in carbon nanowalls

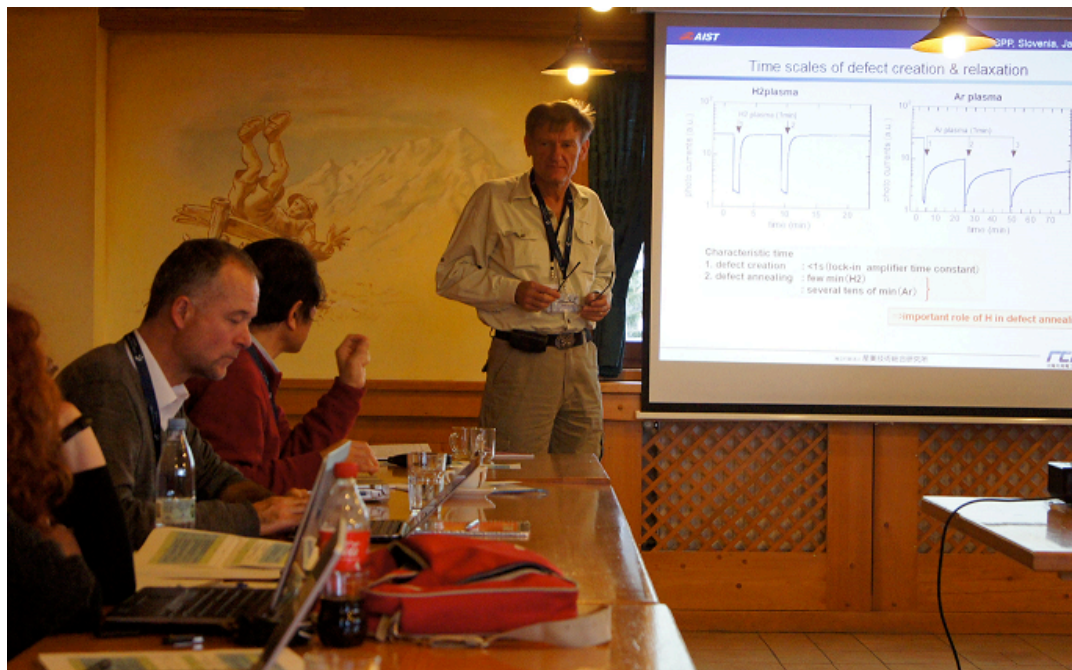


Prof. Gheorghe Dinescu from Bucharest presented an innovative technique for synthesis of nanoparticles



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The scientific activities were chaired by the host, Prof. Miran Mozetic