



# SAPP XXV

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Plasma Processes  
and

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Plasma Processing

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Edited by G. D. Megersa, E. Maťaš, J. Országh, P. Papp, Š. Matejčík

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## Table of Contents

| INVITED LECTURES |                    |  | 11 |
|------------------|--------------------|--|----|
| IL-1             | Cristina Canal     | PLASMA-TREATED HYDROGELS: A THERAPEUTIC ALTERNATIVE IN PLASMA MEDICINE?  | 12 |
| IL-2             | Nicolas Naudé      | DIFFUSE DBD AT ATMOSPHERIC PRESSURE: FROM PHYSICS STUDY TO APPLICATIONS  | 13 |
| IL-3             | Jelena Marjanović  | BREAKDOWN CHARACTERISTICS IN LOW GWP AND LOW ODP FREONS  | 16 |
| IL-4             | Juraj Fedor        | DYNAMICS INDUCED BY ELECTRON COLLISIONS: GASES AND LIQUIDS   | 21 |
| IL-5             | Thierry Belmonte   | DISSOCIATING PURE AMMONIA WITH MICROWAVE DISCHARGES  | 22 |
| IL-6             | Oddur Ingolfsson   | LOW ENERGY ELECTRONS IN NANO-SCALE PROCESSING  | 31 |
| IL-7             | Inna Orel          | SPATIALLY AND TEMPORALLY RESOLVED ELECTRIC FIELD, CURRENT, AND ELECTRON DENSITY IN AN RF ATMOSPHERIC PRESSURE PLASMA JET BY E-FISH   | 34 |
| IL-8             | Dušan Kováčik      | ADVANCED DCSBD-BASED PLASMA TECHNOLOGIES FOR SURFACE MODIFICATIONS AND BIO-APPLICATIONS  | 37 |
| IL-9             | Yuzuru Ikehara     | PLASMA-BASED MICROFABRICATION TECHNOLOGY FOR CHARGE CONTROL METHODS IN PATHOLOGICAL SPECIMENS: VISUALIZING PHASE TRANSITION LINKED WITH VIRUS PARTICLE FORMATION USING SEM AND AFM | 40 |
| IL-10            | Toshiaki Makabe    | GENERAL RELATIONSHIP BETWEEN DRIFT VELOCITIES IN POSITION AND VELOCITY SPACES OF CHARGED PARTICLES   | 42 |
| IL-11            | Máté Vass          | HYBRID FLUID/MC SIMULATIONS OF RADIO-FREQUENCY ATMOSPHERIC PRESSURE PLASMA JETS  | 53 |
| IL-12            | Paula De Navascués | LOW-PRESSURE PLASMA POLYMERIZATION FOR EMERGING FUNCTIONAL MATERIALS   | 57 |
| IL-13            | Jacopo Profili     | INVESTIGATING STABLE SURFACE MODIFICATIONS OF FLUOROPOLYMERS BY ATMOSPHERIC PRESSURE NITROGEN DISCHARGE  | 59 |
| IL-14            | Zoltán Juhász      | RADIATION CHEMISTRY PROCESSES IN THE SURFACE OF ICY MOONS IN THE PLASMA ENVIRONMENT OF GIANT PLANETS   | 61 |
| IL-15            | Jarosław Puton     | SWARMS OF IONS IN VARIABLE ELECTRIC FIELD - POSSIBLE ANALYTICAL APPLICATION  | 66 |
| IL-16            | Masaaki Matsukuma  | MULTISCALE SIMULATION OF PLASMA-BASED DEPOSITION PROCESSES   | 72 |
| HOT TOPICS       |                    |  | 73 |
| HT-1             | Zdenko Machala     | INDOOR AIR CLEANING BY NON-THERMAL PLASMA AND PHOTOCATALYSIS   | 74 |
| HT-2             | Karol Hensel       | ELECTRICAL DISCHARGES IN CAPILLARY TUBES AND HONEYCOMB MONOLITHS   | 77 |

|              |                     |  |     |
|--------------|---------------------|--|-----|
| <b>HT-3</b>  | Pavel Veis          | TRACE ELEMENTS DETECTION AND CF ELEMENTAL ANALYSIS OF WATER BY LIBS FOR ENVIRONMENTAL CONTROL—COMPARISON OF SURFACE ASSISTED, ACOUSTIC LEVITATION AND NE METHODS           | 78  |
| <b>HT-4</b>  | Zoltán Donkó        | THE EFFECT OF NITROGEN ADDITION TO ARGON ON THE Ar 1s <sub>5</sub> AND 1s <sub>3</sub> METASTABLE ATOM DENSITIES AND Ar SPECTRAL EMISSION IN A CAPACITIVELY COUPLED PLASMA | 79  |
| <b>HT-5</b>  | Petra Šrámková      | PLASMA TECHNOLOGY AS AN EFFICIENT TOOL TO IMPROVE SEED GERMINATION AND PROVIDE ADHESION OF PROTECTIVE POLYMER COATINGS ON SEEDS  | 84  |
| <b>HT-6</b>  | Satoshi Hamaguchi   | MOLECULAR DYNAMICS SIMULATIONS OF SILICON NITRIDE ATOMIC-LAYER DEPOSITION OVER A NARROW TRENCH STRUCTURE   | 85  |
| <b>HT-7</b>  | Jan Benedikt        | STABILITY OF METAL-ORGANIC FRAMEWORKS IN NON-THERMAL ATMOSPHERIC PLASMA  | 86  |
| <b>HT-8</b>  | Lenka Zajíčková     | PLASMA PROCESSING OF POLYMER NANOFIBERS FOR ENHANCED IMMOBILIZATION OF LIGNIN NANO/MICROPARTICLES  | 87  |
| <b>HT-9</b>  | Ladislav Moravský   | ATMOSPHERIC PRESSURE CHEMICAL IONIZATION STUDY OF SULPHUR-CONTAINING COMPOUNDS BY ION MOBILITY SPECTROMETRY AND MASS-SPECTROMETRY  | 91  |
| <b>HT-10</b> | Jan Žabka           | HANKA – CUBESAT SPACE DUST ANALYSER WITH PLASMA ION SOURCE   | 95  |
| <b>HT-11</b> | Zlata Kelar Tučková | ATMOSPHERIC PRESSURE PLASMA TREATMENT AND FUNCTIONALIZATION OF GLASS SURFACE FOR RELIABLE ADHESIVE BONDING   | 97  |
| <b>HT-12</b> | Mário Janda         | IN-SITU DIAGNOSTIC OF ELECTROSPRAY BY RAMAN LIGHT SHEET MICROSCOPY   | 99  |
| <b>HT-13</b> | Matej Klas          | MEMORY EFFECT IN PULSED MICRODISCHARGES  | 105 |
| <b>HT-14</b> | Ihor Korolov        | STREAMER PROPAGATION DYNAMICS IN A NANOSECOND PULSED SURFACE DIELECTRIC BARRIER DISCHARGE IN HELIUM-NITROGEN MIXTURES  | 107 |
| <b>HT-15</b> | Oleksandr Galmiz    | GENERATION OF REACTIVE SPECIES VIA SURFACE DIELECTRIC BARRIER DISCHARGE IN DIRECT CONTACT WITH WATER   | 110 |

## YOUNG SCIENTISTS' LECTURES

114

|             |                    |  |     |
|-------------|--------------------|--|-----|
| <b>YS-1</b> | Kristína Trebulová | COLD PLASMA AS AN APPROACH TOWARDS ALTERNATIVE TREATMENT OF OTITIS EXTERNA   | 115 |
| <b>YS-2</b> | Richard Cimermann  | PLASMA-CATALYTIC GAS TREATMENT: THE ROLE OF PELLET-SHAPED MATERIAL IN PACKED-BED DBD REACTORS  | 118 |
| <b>YS-3</b> | Barbora Stachová   | ELECTRON INDUCED FLUORESCENCE OF CARBON MONOXIDE   | 120 |
| <b>YS-4</b> | Joel Jeevan        | EFFECT OF DILUTION OF H <sub>2</sub> /CH <sub>4</sub> MICROWAVE MICROPLASMA WITH ARGON FOR IMPROVED GAS PHASE NUCLEATION OF NANODIAMONDS | 125 |
| <b>YS-5</b> | Anja Herrmann      | MAPPING RADICAL FLUXES WITH THERMOCOUPLE PROBES  | 131 |

# TRACE ELEMENTS DETECTION AND CF ELEMENTAL ANALYSIS OF WATER BY LIBS FOR ENVIRONMENTAL CONTROL- COMPARISON OF SURFACE ASSISTED, ACOUSTIC LEVITATION AND NE METHODS.

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Elemental analysis of water circulating in nature (e.g., water from springs, lakes, rivers, polluted groundwater near environmental contaminants, and wastewater released from factories) is highly important. Pure natural water primarily contains elements such as C, N, O, H, alkali metals, alkaline earth metals, and other trace elements essential for life. However, pollutants like heavy metals or other elements introduced through industrial environmental pollution may also be present (e.g., Cd, Pb). Monitoring these elements in groundwater is crucial for assessing water quality.

Laser-Induced Breakdown Spectroscopy (LIBS) is a method offering rapid detection and quantification of all elements present in natural water samples, including heavy metal pollutants, which is critically important for environmental protection and public health.

Elemental analysis of water samples using LIBS remains challenging due to issues such as splashing and plasma quenching by water products [1]. Several LIBS-based methods have been developed to address these challenges, such as surface-enhanced (SE) or surface-assisted (SA) LIBS, where liquid droplets are dried on a solid surface [2,3,4], or using absorption in zeolites to capture pollutants from water samples [5].

Acoustic levitation (AL) of isolated droplets, achieved by creating an ultrasonic standing wave in an acoustic resonator, is a sampling technique that enables LIBS analysis of liquids without contact with a solid substrate [6,7]. In this method, controlled evaporation using CW-IR laser radiation leads to the preconcentration of water samples around hundred times. Another method for enhancing the LIBS signal of water-based samples is nanoparticle (NP) enhancement (NE). This technique is often combined with SE or SA LIBS methods. Recently, our group used this approach to compare different beverages (drinking water, wine, beer) by employing varying concentrations of three different types of spherical metal nanoparticles (Au, Ag, Cu) [8]. Additionally, NE-LIBS combined with AL was utilized in our group to analyze heavy metals (Cd, Pb) in water using Ag nanoparticles.

These two liquid LIBS analysis methods (SA LIBS and LIBS AL), both with and without NP enhancement, will be compared for the elemental analysis of various types of water- and alcohol-based liquids using time-resolved, broadband UV-NIR Echelle-based spectroscopy. Recent results regarding the limit of detection (LOD) for boron in water samples using the LIBS AL method will also be presented [9].

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