MICROPLASMAS: Where Science Meets Engineering and Technology

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Systematic studies of atmospheric-pressure plasmas in the 1980s showed that non-equilibrium plasma conditions with electron energies substantially higher than those of heavy particles, and properties resembling those of low-pressure glow discharges, can exist also at much higher pressure, e.g. at atmospheric pressure. Moreover, single collision conditions no longer prevail in high-pressure plasmas, so step-wise processes such as electron-impact excitation of excited states and collisions of excited species with other particles resulting in new energy transfer routes and three-body collisions leading e.g., to the formation of excimers become prominent. However, self-sustained diffuse discharges tend to be unstable at high pressure due to their susceptibility to filamentation and the transition to an arc, which limits their practical utility. Among the most frequently employed approaches to achieve stabilization are (1) pulsed excitation, which essentially extinguishes the glow phase of the plasma before the glow undergoes the transition into an arc and (2) confining the plasma in a cavity, where at least one dimension is below ~1 mm, so-called microplasmas, in which interactions of the plasma with the surrounding wall/boundary contribute to the stabilization. This talk presents some basic properties of high-pressure (micro)plasmas, discusses some of their characteristic properties, and subsequently introduces several biological, biomedical, and medical applications of microplasmas. The importance of plasma-surface interactions in all these applications will be highlighted.

Bio Sketch of Kurt H. Becker - Kurt Becker is an international expert in the areas of the experimental plasma science and technology and collision physics. He is well known for his research into the basic properties of atmospheric-pressure microplasmas and their technological exploitation in areas such as surface modifications and environmental, biological, and biomedical applications. He holds 7 US patents on stable atmospheric-pressure plasmas and their application and was involved in their commercialization.

He is currently the Associate Provost for Research and Technology Initiatives at the Polytechnic Institute of NYU (NYU-Poly) and a Professor in the Dept. of Applied Physics and the Dept. of Mechanical and Aerospace Engineering. Prior to joining NYU-Poly in 2007, he was Associate Director of the Center for Environmental Systems at Stevens Institute of Technology (2003–2007) and Professor (1997-2007) and Head of the Physics Department (2000-2007). He also held faculty positions at Lehigh University (1984–1988) and at the City College of CUNY (1988–1997). He earned a Diplom in Physik (MS) and Dr. rer. nat. (PhD) from the Universität des Saarlandes, Saarbrücken, Germany in 1978 and 1981, respectively.

Kurt Becker is a Fellow of the American Physical Society, the recipient of the Dr. Eduard-Martin Prize for Excellence in Research from the Universität des Saarlandes, the Thomas Alva Edison Patent Award, and the SASP Erwin Schrödinger Medal. He also holds an honorary Professorship at the Leopold Franzens Universität Innsbruck, Austria.

He has written over 200 articles in refereed journals and books and has over 400 conference presentations and abstracts. In addition, he has served on the editorial boards of numerous journals and was an invited speaker presenter at many national and international conferences. He is currently also the Editor-in-Chief of the European Physical Journal D.