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A Novel Design of Radio Freqiency Inductively Coupled Plasma (RF-ICP) torch and it applications for Coatings

Abstract:
A novel conical radio frequency inductively coupled plasma (RF-ICP) torch is introduced, and its potential for coating applications under both atmospheric and low-pressure conditions is explored. Compared to conventional cylindrical ICP torches, the conical geometry enhances plasma confinement and improves coupling between the electromagnetic field and the plasma, enabling stable operation over a wide pressure range.
A key advantage of the proposed design is its improved energy efficiency and reduced gas consumption. Previous studies on conical ICP torch configurations have demonstrated significant reductions in argon flow and more than a fourfold higher power density compared to traditional cylindrical torches. The conical configuration promotes more effective power deposition into the plasma core, allowing operation at lower input power while maintaining high plasma temperatures.
These advantages are particularly valuable for coating applications, where efficient particle heating, stable plasma structure, and controlled transport are essential. The proposed torch is suitable for atmospheric plasma spraying and emerging low-pressure plasma-assisted deposition processes and also exhibits strong potential for efficient powder spherodization under atmospheric conditions. Overall, the conical RF-ICP torch provides a versatile and scalable platform that overcomes key limitations of conventional cylindrical designs for advanced coating technologies.

Biography:
Dr. Javad Mostaghimi, FASM, TSS-HoF, is a Professor in the Department of Mechanical & Industrial Engineering at the University of Toronto and the founding director of the Centre for Advanced Coating Technologies (CACT). His main research interests are the study of thermal spray coatings, Professor Mostaghimi has done extensive simulations of droplet impact and solidification dynamics in thermal spray processes and has designed several novel DC and RF plasma torches. Professor Mostaghimi is a fellow of the several societies, including: RSC (Royal Society of Canada), ASME, CSME, EIC, CAE, and AAAS, IUPAC. He has received numerous awards, including ASME Heat Transfer Memorial Award, ASME Fitz Roy Medal, and NSERC Brockhouse Canada Prize. Dr. Mostaghimi is a Fellow of the US National Academy of Inventors, a member of the editorial board of Plasma Chemistry and Plasma Processing and a member of the International Review Board of the Journal of Thermal Spray.