POLYTECHNIQUE MONTRÉAL

LE GÉNIE EN PREMIÈRE CLASSE

SÉMINAIRE DU DÉPARTEMENT DE GÉNIE PHYSIQUE

Jeudi 15 octobre 2020 – 10h30

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Energy Conversion Plasmas: Using Non-Centrosymmetric Crystals to Convert Thermal and Mechanical Energy into Plasma Generation

Non-equilibrium plasmas are one of the unsung heroes of modern science and engineering and central to a number of emerging applications in fields as diverse as healthcare and environmental management to agriculture and transportation. However, one of the challenges in the application of plasma devices in any of these fields is that they inherently require high voltages – upwards of kilovolts and beyond – to operate. This makes developing portable plasma devices that can be taken into field applications, such as disaster areas or developing regions, and limits plasma equipment to laboratories or similarly suited facilities. One approach to overcoming this limitation is to develop devices and sources that directly convert another form of energy – such as thermal or mechanical energy – directly into plasma generation. Such 'energy conversion plasmas' could be based on an energy harvesting strategy, utilizing abundant other forms of energy to operate, rather than their own high-voltage power supply. Non-centrosymmetric crystals, which are crystalline materials where the unit cell does not have a central point of symmetry, provides one potential approach to energy conversion plasmas, where pyroelectric and piezoelectric materials can be used to convert heat or mechanical motion into a plasma, respectively. In this talk, I will overview our efforts in this area, including our work with piezoelectric transformers1-3 and pyroelectric crystals4, and most recently, with spark igniters5. I will discuss our findings and innovations, the challenges we have faced, and potential opportunities for future efforts.

1. [1]- *Johnson, M.J. and Go, D.B., 2015. Piezoelectric transformers for low-voltage generation of gas discharges and ionic winds in atmospheric air. Journal of Applied Physics, 118(24), p.243304.*
2. *Johnson, M.J. and Go, D.B., 2016. Impingement cooling using the ionic wind generated by a low-voltage piezoelectric transformer. Frontiers in Mechanical Engineering, 2, p.7.*
3. *Yang, J., Im, S.K. and Go, D.B., 2020. Time-resolved characterization of a free plasma jet formed off the surface of a piezoelectric crystal. Plasma Sources Science and Technology, 29(4), p.045016.*
4. *Johnson, M.J., Linczer, J. and Go, D.B., 2014. Thermally induced atmospheric pressure gas discharges using pyroelectric crystals. Plasma Sources Science and Technology, 23(6), p.065018.*
5. *Jaenicke, O.K., Hita Martínez, F.G., Yang, J., Im, S.K. and Go, D.B., 2020. Hand-generated piezoelectric mechanical-to-electrical energy conversion plasma. Applied Physics Letters, 117(9), p.093901.*

Vous êtes tous les bienvenus.

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David B. Go is the Rooney Family Collegiate Professor of Engineering and Department Chairman-elect in the Department of Aerospace and Mechanical Engineering at the University of Notre Dame, with a concurrent appointment in the Department of Chemical and Biomolecular Engineering. He has published widely in the areas of plasma science and engineering, heat transfer and fluid dynamics, and chemical analysis and holds 6 patents or patent applications, leading to two licensed technologies. Prof. Go has been recognized with the Air Force Office of Scientific Research Young Investigator Research Award, the National Science Foundation CAREER award, the Electrochemistry Society Toyota Young Investigator Fellowship, the Electrostatics Society of America Rising Star Award, and the IEEE Nuclear & Plasma Sciences Society Early Achievement Award. He is an ASME Fellow and the President of the Electrostatics Society of America. At Notre Dame, he has received the Rev. Edmund P. Joyce, C.S.C. Award for Excellence in Undergraduate Teaching and is a Kaneb Center for Teaching and Learning Faculty Fellow. Prior to joining Notre Dame in 2008, Prof. Go received his B.S. in mechanical engineering from the University of Notre Dame and was a design engineer at General Electric Aviation, where he completed the Edison Engineering Development Program and concurrently received M.S. in aerospace engineering from the University of Cincinnati. After leaving GE Aviation, he received his Ph.D. degree in mechanical engineering from Purdue University.

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