AAPPS-DPP 2018 Plenary speaker Name: Prof. Kwo Ray Chu
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Rationale: Radio frequency (RF) and microwave heating of dielectric objects *is often susceptible to an excessive temperature spread due to uneven energy deposition. The exposure to a non-uniform field is a well-studied cause for this difficulty encountered in numerous applications. There are, however, some less-understood causes, which are inherent in nature in that they persist even in a perfectly uniform field. Of these causes, s*omewhat less obvious is the polarization charge shielding effect. The polarization-charge shielding effect in microwave heating is a plasma phenomenon occurring in dielectrics, which has the following significances:

1. It is the first focused study on the heating non uniformity due to polarization-charge shielding effect, which has so far received little attention in literature.
2. Novel methods are used for an isolated examination of individual causes.
3. The results provide an in-depth understanding of the most persistent difficulty encountered in microwave/RF control of insects in farm products.
4. The physics, methods, and results reported here can be a useful reference for a wide range of microwave heating applications.

It is valuable to present above issues as a plenary talk which belongs to the category of "Plasma sources, electromagnetic waves and radiations, plasma heating" in the section of basic plasma

Talk Title: A study of inherent causes for non-uniform microwave heating

Short abstract: Radio frequency (RF) and microwave heating of dielectric objects *is often susceptible to an excessive temperature spread due to uneven energy deposition. The exposure to a non-uniform field is a well-studied cause for this difficulty encountered in numerous applications. There are, however, some less-understood causes, which are inherent in nature in that they persist even in a perfectly uniform field. We present an experimental study on some main inherent causes with rice grains as samples. Of these causes, s*omewhat less obvious is the polarization charge shielding effect[1,2]. Exposed to an electromagnetic wave, *electrical charges in the dielectric object react in a way to partially shield the wave electric field. As a result, the* dielectric object's interior electric field can be significantly smaller than the incident electric field, resulting in much reduced power deposition as well as orientation- and shape-sensitive heating rate. *Experiments are conducted in an applicator[3], in which samples are irradiated by a 24 GHz microwave. High radiation uniformity (~99%) and polarization control allow a quantitative examination of each cause. Their individual and collective effects are found to be highly significant. In particular, polarization-charge shielding alone can result in a temperature spread of* ~18.2% *for the samples examined. Physical interpretations are given and an effective method for its mitigation is demonstrated.*

This study provides *an in-depth understanding of* the most persistent difficulty encountered in RF and microwave insects control for farm products (rice in particular). Since the causes studied are of a common nature, the physics, methods, and results reported here can hopefully be a useful reference *for a wide range of microwave heating applications.*

[1] M. S. Lin, S. M. Lin, W. Y. Chiang, L. R. Barnett, and K. R. Chu, Phys. Plasmas 22, 083302 (2015).
[2] Y. F. Tsai, L. R. Barnett, H. H. Teng, C. C. Ko, and K. R. Chu, "A study of some inherent causes for non-uniform microwave heating," Phys. Plasmas 24, 103301 (2017).
[3] W. Y. Chiang, M. H. Wu, K. L. Wu, M. H. Lin, H. H. Teng, Y. F. Tsai, C. C. Ko, E. C. Yang, J. A. Jiang, L. R. Barnett, and K. R. Chu, Review of Scientific Instruments 85, 084703 (2014).