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COUPLING OF TWO OSCILLATIONS OF CLOSE FREQUENCIES IN A HIGH PRESSURE PLASMA ENCLOSED IN A SPHERICAL BULB

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In an applied research project on a pulsed microwave sulfur lamp prototype of 1 kW, fitted with a rotation less and electrode less spherical bulb, we discovered that the plasma may form, despite gravity, a ball of about half the bulb size, settled in the center. In a preceding publication, we then reported measurements performed with a photodiode that shows the high-pressure plasma response to short microwave pulses, and we showed by modelization that the ball formation results from an acoustic resonance in a spherical mode. Out of this formation, the signal AC component has the same frequency as the pulse rate, and resembles to a triangular signal, rising during the ON periods and falling back during the OFF periods. When the ball formation occurs, at a pulse rate a little below 30 kHz, the AC component changes to a sinusoidal signal of a slightly lower frequency, and beats appear with a frequency equal to the frequency shift. In the preceding publication, it was demonstrated that the beats could result from the simultaneous excitation of two normal modes, because they have a frequency difference matching the observed frequency shift. As the higher of the two frequencies is the pulse rate, the one is due to a forced oscillation, whereas the other one is due to a free oscillation. In this article, we study the dissipation due to bulk viscosity and, thus, identify a mechanism that can couple the two oscillations, explaining the simultaneous excitation.

Biography

Gilles Courret has completed his PhD at the Swiss Federal Institute of Technology (EPFL) in 1999. Since 2013, he is Professor of Physics in the Department of Industrial Technologies of the University of Applied Sciences and Arts Western Switzerland (HES-SO). His research interests include Microwave-Plasma Interaction, Plasma Chemistry, Light Sources and Illumination Engineering, with Emphasis on the Improvement of Energy Efficiency. He has published more than 20 papers in reputed journals.

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