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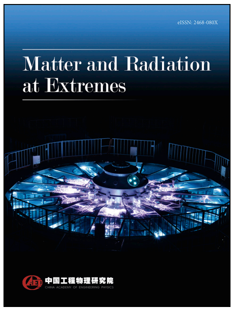

Public Debate on Metallic Hydrogen to Boost High Pressure Research

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Public Debate on Metallic Hydrogen to Boost High Pressure Research

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Instead of praises from colleagues, the claim of observation of metallic hydrogen at 495 GPa by Dias and Silvera met much skeptism, and grew into a public debate at the International Conference on High-Pressure Science and Technology, AIRAPT26. We briefly review this debate, and extend the topic to show that this disputation could be an oppurtunity to benefit the whole high pressure community.

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It is well known that public debate has been playing a pivotal role in the history of science. One of the well-known cases is the Bohr-Einstein debate, which greatly boosted the development of quantum mechanics. Recently, a similar debate appeared at *the International Conference on High-Pressure Science and Technology*, AIRAPT26, an important gathering of global high-pressure experts, on a recent claim of metallic hydrogen.

Metallic hydrogen (MH), referred to hydrogen in a metallic state [1], is dubbed as the *Holy Grail* in the high-pressure community. Quantum mechanics tells that every material can come into metallic state under high enough compression, which should also be the case for hydrogen. However, things became fascinating when Ashcroft added a flavor into it by predicting that MH could become superconducting at room temperature [2], as well as accompanying bizarre and interesting phenomena might be observed when protons became quantized [3,4]. These predictions together with the possibility that MH could be a strong explosive with ultra-high energy density, make MH a wonder material attracting the attention of experimentalists in high-pressure community. However, the challenge in pursuing MH is tremendous due to the notorious activity of hydrogen. Modern accurate theories predict that the transition into MH happens at a pressure ~500 GPa [5,6], whereas the most advanced diamond anvil cell (DAC) used for compression is limited to ~400 GPa on hydrogen. It is a huge surprise to the high-pressure community when Dias and Silvera (DS) claimed that they have achieved a pressure as high as 495 GPa and obtained MH in laboratory [7]. Their statement immediately caused backfire, and at least four leading groups in this field doubted the authenticity of the sensational discovery [8-12]. This fierce debate eventually went to public at the AIRAPT26 conference, held in Beijing in August 2017.

The debate mainly focused on three points: (1) the pressure calibration problem, (2) the credibility of the diamond Raman spectrum which implied a pressure of 495 GPa, and (3) whether the observation of reflectance alone is sufficient to claim the generation of MH. Without any internal pressure calibration, DS relied on a very special secondary pressure scale, the linear extrapolation of the load curve, to guide the DAC loading in the blind stage (>335 GPa) [7]. In principle, this is valid if the pressure of the final state could be reliably determined. But the possible interference from fictitious Raman peaks, which are frequently encountered at high pressures before the diamonds break, as Eremets pointed out [10], suggests that only one Raman spectrum is not enough to completely pin down the final pressure reliably. People thus have to resort to the peculiar