Experimental study on the pressure-generation efficiency and pressure-seal mechanism for large volume cubic press

Jiawei Zhang[1,2], Duanwei He[1,2*]

[1] *Institute of Atomic and Molecular Physics, Sichuan University, Chengdu 610065, China.*
[2] *Key Laboratory of High Energy Density Physics and Technology of Ministry of Education, Sichuan University, Chengdu 610065, China.*

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*e-mail: duanweihe@scu.edu.cn

Experiments conducted with cubic press could maintain a large sample volume and achieve relatively stable and uniform heating. For these reasons, the large volume cubic press has been a popular device for high-pressure synthesis of super-hard materials in industry and high-pressure research in laboratories. Measuring the pressure of gasket (P_g) and cell (P_c) *in situ* is the key point to understand the mechanism of pressure-generation and pressure-seal for the widely used large volume cubic press. However, it is a challenge to measure P_g due to the large deformation in the gasket zone and the complex rheological behavior of the pressure transmitting medium (PTM). Although finite-element analysis could simulate the pressure distribution in pyrophyllite gasket and high-pressure cell in a cubic press, it has not yet been experimentally verified and the measuring of P_g is still a challenge.

The talk will introduce an experimental method to measure the pressure of gasket for the widely used large volume cubic press. Based on the results of pressure calibration during the compression and decompression process, the mechanisms on pressure-generation and pressure-seal are discussed. It was found that P_c generated in the large volume cubic press was limited to the rapid rise of P_g above 5 GPa. And the larger the ΔP ($\Delta P = P_c - P_g$), the high-pressure cavity seal failure, so called "blowout", is more likely to occur.

Moreover, a criterion for assessing the performance of the high-pressure assembly was proposed and used to study the optimization design of the size of PTM and the compression process.

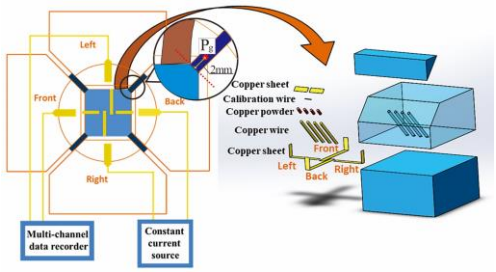

Figure 1. Schematic illustration of the circuit and assembly used for measuring gasket pressure

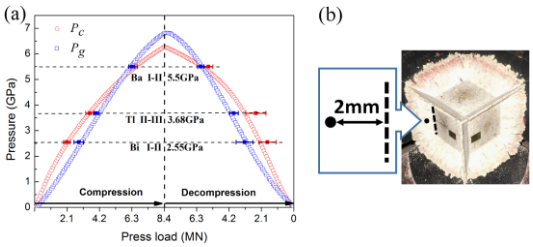

Figure 2. Comparison of Pc and Pg. (a) Pc and Pg as a function of the press load. (b) The optical photo of the pyrophyllite cube after high-pressure experiments.

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