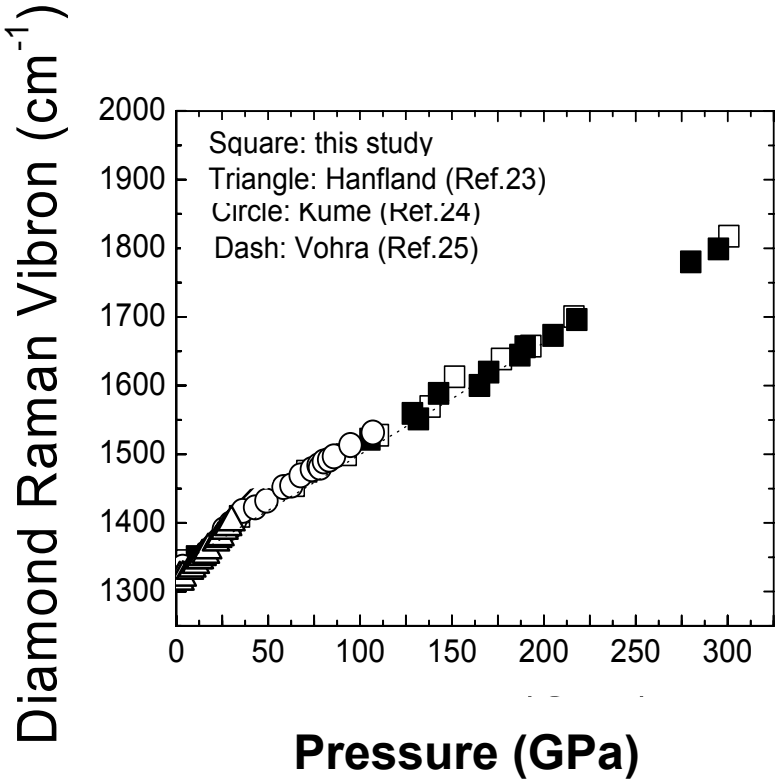
A New Optical Pressure Gauge to 301 GPa

Arthur L. Ruoff, Cornell University, DMR-0304745

We have developed an easy to use optical pressure gauge based on the Raman Spectroscopy of diamond at the center of the diamond tip, which has been calibrated to 301 GPa and, we believe, can be calibrated to much higher pressure, and as it is a linear gauge, can be reasonably extrapolated to higher pressures in the interim. The nonlinear ruby gauge had earlier been calibrated to 180 GPa and was extrapolated higher. There has been a need for a simple pressure gauge above 200 GPa since 1990 when pressures of 560 GPa were reached and measured in our group by the x-ray marker method using a synchrotron.

Such pressures are useful in studying the nature of matter at high pressures, in studies making new materials at high pressure and in the study of geology of the earth and the planets of our solar system.



Raman frequency vs. pressure is the basis of a new inexpensive, easy to use optical pressure gauge.

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Education:

Postdoctoral Associate, Dr. Liling Sun, is now the only young scientist (below 40) in the U.S. who has attained pressures over 300 GPa. She learned the technique here. The poster presentation of this project by her was selected as the best poster at the Gordon Research Conference on Research at High Pressure held June 27 – July 1, 2004.

Societal Impact:

Man is differentiated from other creatures by the ability to ask questions, and by the ability to carry out experiments and to use critical analysis to seek the answers to such questions as: What does ultrapressure do to the properties of solids? How may this knowledge be used to improve quantum mechanical calculations? How may this knowledge be used to make new materials? How may this knowledge be used to understand the geology of our earth and the nature of planets?