# EXAFS study of Mott-Anderson transition in germanium monoxide

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Mott-Anderson transition [1], where a disordered system undergoes insulator – metal transition, is a very rare event. Some years ago we have shown that SiO turns metallic under 12 GPa, while its X-ray absorption data shows a typical hump of an amorphous material up to 30 GPa [2]. This turned SiO to be a good candidate to demonstrate a Mott-Anderson transition. However, in order to eliminate the possibility that metallization occurs due to disproportionation of SiO to $Si+SiO_2$, it would have been desirable to perform EXAFS studies on SiO under these pressures. Also, in case it turns out that indeed a Mott-Anderson transition occurred, XANES could give valuable information on the change in band structure that relates to this transition, and might help assert if it is the lone-pair [2] of the Si atom that delocalizes. Unfortunately, such a measurement is not feasible since the K edge of Si is at a very low energy that would be heavily absorbed by the diamonds in a diamond anvil cell (DAC). To tackle this problem from a different angle we studied the analogue material, GeO. We have found that GeO is X-ray amorphous to 23 GPa (see fig.1,) and that it also becomes metallic at ~12 GPa (see fig.2,) while its K-edge value (~11 KeV) allows performing EXAFS and XANES in a DAC.

We have performed EXAFS and XANES on GeO up to 15 GPa at IDI-20 beamline at DIAMOND. Mott-Anderson transition is not expected to make drastic changes in the EXAFS spectrum apart from a possible shift of the K edge of the Ge atom, which was the case. Disproportionation and onset of metallicity due to creation of Ge-Ge chains, which would most probably had altered the EXAFS and XANES spectra markedly was not observed.

The preliminary data shown here, which was the motivation for the EXAFS study, shows in figure 1 that presents the amorphous nature of the germanium monoxide both below and above the transition pressure. In figure 2 we show the temperature dependence of the electrical resistance of the sample at different pressures.

The Group IV-VI binary compounds exhibit very diverse chemistry [3]. The bond types of this group cover the full range of covalent, semiconductor and metallic. The nine IV-VI semiconductors (Ge, Sn, Pb)-(S, Se, Te) have been subject to a number of experimental studies concerning their pressure induced phase transitions [4]. The two layered monoxides, PbO and SnO, have also been extensively studied under high pressure (e.g. [5], [6]). SiO and GeO are odd in this group, since they are not known to exist in a crystalline form at room conditions, and their commercial availability in an amorphous form is scarce.

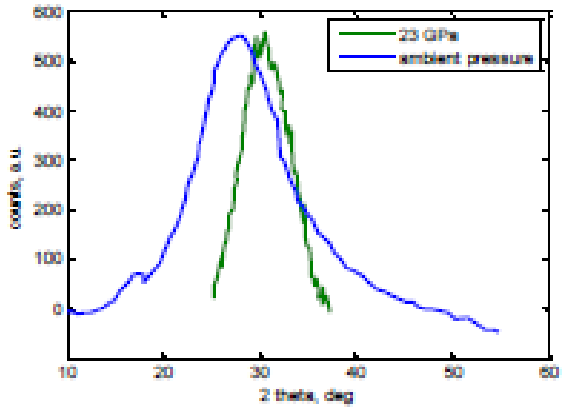


*Figure 1*. X ray absorption on GeO shows its amorphous nature at ambient and at 23 GPa pressures, below and above the metallization that occurs at ~12 GPa

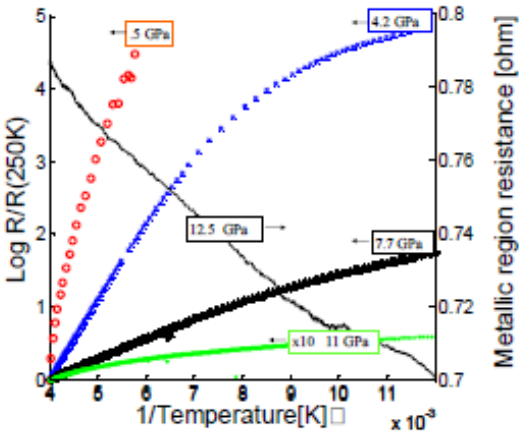


*Figure 2*. Temperature dependence of the electrical resistance of the GeO sample at different pressures

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