BOSON PEAK IN NEUTRON-IRRADIATED QUARTZ CRYSTAL

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Optical, thermal and acoustical properties of amorphous solids differ strongly from those of crystals. An interesting feature of their vibrational dynamics is a broad band observed in Raman scattering spectra in low frequency region. This band is identified as the boson peak. The origin of this boson peak is still under debate. As shown in [1] it can be explained by interaction of soft quasilocal harmonic atomic vibrations, which together with two-level systems are the general features of the glassy state. The same anomalous properties were investigated in crystalline quartz irradiated with fast neutrons [2].
Neutron irradiated quartz is a very attractive model for the glassy state because one can introduce different degrees of disorder in a perfect crystal by varying the neutron dose. In this paper we report our Raman scattering measurements for neutron irradiated quartz in the low frequency range - from 15 cm^{-1} to 150 cm^{-1}. The irradiation dose was $4.7 \cdot 10^{19}$ n/cm^2 ($E > 0.3$ MeV), which leaves the sample mainly crystalline (70%), but this dose is situated in the beginning of the so-called "threshold region", where significant structural changes start to take place. Our measurements show the existence of the boson peak at 60 cm^{-1} and a crystalline peak at 128 cm^{-1}.

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