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Phonon confinement gap in CeO_2 nanocrystals

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The phonon density of states (PDOS), which plays an important role in the mechanisms that determine the unique physical properties of nanocrystals (NCs), strongly depends on the reduced size of the NC.

While these confinement effects are often invoked to explain surprising results, the direct study of lattice dynamics in NCs is difficult.

Theoretically, it is shown that as the NC size decreases, the gapless and continuous PDOS observed in the bulk becomes discrete and is characterized by a cutoff in the low-frequency part of the spectrum – the so called phonon confinement gap.

Here we present our measurements of the PDOS of both nanocrystalline and bulklike microcrystalline samples of CeO_2 with high resolution cold TOF neutron spectrometer LET.

The data obtained allow us to investigate the size effects on PDOS and extract the phonon confinement energy gap.

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