Sb and Te spectroscopy in backscattering geometry

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Nuclear inelastic scattering (NIS) for resonance above 30 keV were made possible through the development of sapphire backscattering monochromatization. We will discuss these developments in method and instrumentation for the ^{121}Sb and ^{125}Te resonances. The latest addition in capabilities at Petra III, P01 have required better focusing and purity management and have involved the development of miniature pressure cells for measurements at high pressure and low temperature[1]. The method has found a range of applications in material science and biochemistry, the latest reports spanning pressure induced phase transition[1] in TeO_2, bonding modifications in the $Sb_2(Se,Te)_3$ solid solution[2], combined NIS and inelastic neutron scattering studies of vibrational modes in lone-pair Sb_2O_3 compounds[3], vibrational analysis in [4Fe-4Te] metalloproteins[4], and bio-reduction of Sb(V) to Sb(III)[5]. For future developments, a reduction in beam size will lead to a tremendous gain in quality and data acquisition rate.

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1. Sergueev I., *et al.*, High-pressure nuclear inelastic scattering with backscattering monochromatization, *J. Synch. Rad.* **26**, 1592 (2019).
2. Herrmann M. G., et al., Lattice dynamics of Sb_2Se_3 from inelastic neutron and X-ray scattering, *Physica Status Solid B* **257**, 2000063 (2020).
3. Jafari A., *et al.*, Phonon Spectroscopy in Antimony and Tellurium Oxides, *J. Phys. Chem. A* **124**, 7869 (2020).
4. Wittkamp F., *et al.*, Insights from ^{125}Te and ^{57}Fe nuclear resonance vibrational spectroscopy: a [4Fe–4Te] cluster from two points of view, Chem. Sci. **10**, 7832 (2019).
5. Chistyakova N., *et al.*, Mössbauer, nuclear forward scattering and Raman spectroscopic approaches in the investigation of bioinduced transformations of mixed-valence antimony oxide, *J. Phys. Chem. A*, *in press* (2021).