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SXMCD study of magnetic adatoms on Bi_2Se_3 and Bi_2Te_3 single crystals

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The topologically protected electronic surface states were extensively studied in Bi_2Se_3 and Bi_2Te_3 by means of ARPES. Similarly to graphene, these materials were predicted to exhibit a single Dirac cone, that is protected by time reversal symmetry. This symmetry can be broken by introducing magnetic elements with a net out-of-plane magnetic moment [1,2]. Magnetic impurities not only change the electronic properties of the parent material but also introduce magnetic order to the system, for instance Bi_2Te_3 doped with Mn shows ferromagnetic order below 12 K depending on the Mn concentration [3].

In this contribution we present SXMCD studies of magnetic properties of adatoms (and dopants) on (in) single crystals of Bi_2Se_3 and Bi_2Te_3. At first, we discuss the methodology of the measurements, that allows to detect high quality spectra at low levels of doping. A detailed analysis of XAS shape suggests that adatoms usually exhibit an atomic electronic configuration equal to that of the free atom. Element specific magnetization profiles of adatoms were fitted using a thermodynamical model including Zeeman splitting and magnetic anisotropy. Depending on the adatom/substrate combination, different types of anisotropy – either uniaxial out-of plane or basal ion-plane easy axis – is revealed. However, the magnetic moments of bulk magnetic dopants exhibit nearly isotropic magnetic properties.

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Investigation of defect structure in undoped calcium molybdate single crystals ($CaMoO_4$) by means of X-ray diffraction methods

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The aim of the present study was the characterisation of crystal lattice defects of calcium molybdate $CaMoO_4$ crystals, which are suitable materials for many applications in acoustic-electronics, acoustic-optics, nonlinear optics, as laser hosts and scintillators, solid state lasers, different kinds of substrates and active elements of ionizing radiation detectors. For all these applications the large-sized single crystals of high structural quality are required.

The samples were investigated by means of synchrotron white beam topography, monochromatic beam topography and conventional X-ray Lang projection topography. The high resolution rocking curves were also taken using synchrotron and conventional arrangements.

The topographs of $CaMoO_4$ indicated a considerably good crystallographic perfection of the crystals. In particular they did not reveal any segregation fringes proving high homogeneity of chemical composition. Relatively high densities ($< 10^4$ cm^{-2}) of weak point like contrasts, which can be most probably interpreted as dislocation outcrops, were observed.

The visible imperfection of the investigated crystals was variously developed block structure. The evaluation of lattice misorientation was realised by means of superimposed projection and section white beam synchrotron radiation topographs. The evaluated misorientation between various blocks was in the range of several arc minutes.

The block structure is generally caused by cracks during the cooling process. It can be connected with thermal stresses.

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