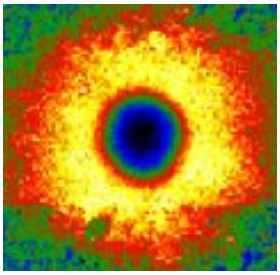

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Signal oscillations in helium scattering by bismuth atoms in low energy range

Low Energy Ion Scattering spectroscopy (LEIS) analysis of bismuth selenide (Bi2Se3), a strong 3D topological insulator, revealed oscillations of the detected signal in dependence on primary ion beam energy.
Bismuth is a part of the group of elements where oscillatory behaviour was already noticed, such as gallium, indium or lead. Generally, it is ascribed to quasi-resonant charge exchange processes between primary ion and target atom. Unlike in the case of indium, oscillations of the bismuth signal were described as more irregular. At the same time, some regular patterns in oscillatory wave behaviour can be seen. Moreover, clear differences exist between data for target atoms in elemental form and for atoms in compound form, as was described in the case of indium and indium arsenide crystals. Recently, the effect of impurities was described to cause ion yield oscillations in the analysis of lanthanum surfaces.
In our research, a study of Bi signal yields in different forms of material was performed for primary He+ projectiles within the wide energy range from 0.50 to 6.00 keV. A dedicated HS-LEIS instrument with a scattering angle of 145° and perpendicular incidence was used. Pure Bi film, Bi2Se3, Bi2O3 and thin Bi films deposited on several substrates by Molecular Beam Epitaxy (MBE) were analysed. The shift in the position of oscillations was observed when the oxygen atoms were presented and bonded to Bi atoms (see Figure). The comparison of the inverse velocity dependences was also made. As the quantification analysis in LEIS is more difficult when different neutralization processes are involved, further focus on this behaviour is still desirable. We want to provide a detailed description of the Bi ion yield variation to enhance the field of the quantification process in LEIS.

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