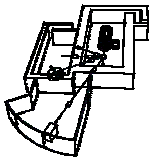
Institut für Strahlenphysik



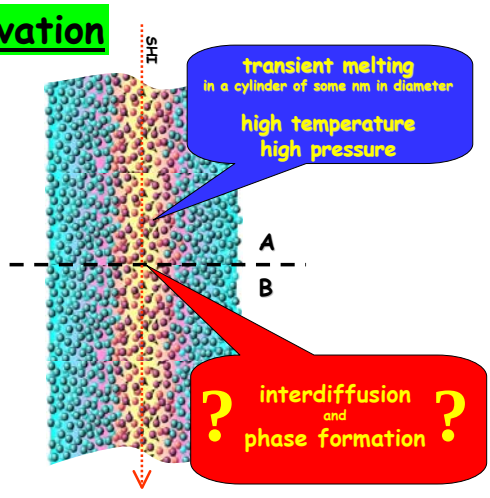
# Swift Heavy Ion Induced Phase Formation at NiO/Si-Interfaces

Universität Stuttgart

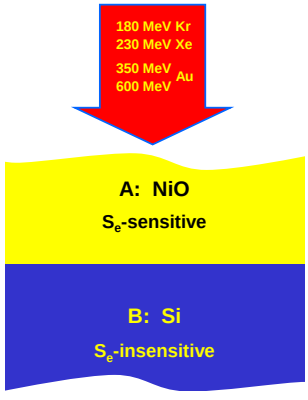
C. Dais[1], T. Bolse[1], B. Schattat[1,2], W. Bolse[1], P. Schubert-Bischoff[2], J. K. N. Lindner[3]

[1]Institut für Strahlenphysik, Universität Stuttgart;
[2]Hahn-Meitner-Institut, Berlin; [3]Institut für Physik, Universität Augsburg

## Motivation




## Experiment




**Irradiation at 80 K:**

Ionenstrahllabor (ISL) of Hahn-Meitner Institut (HMI)

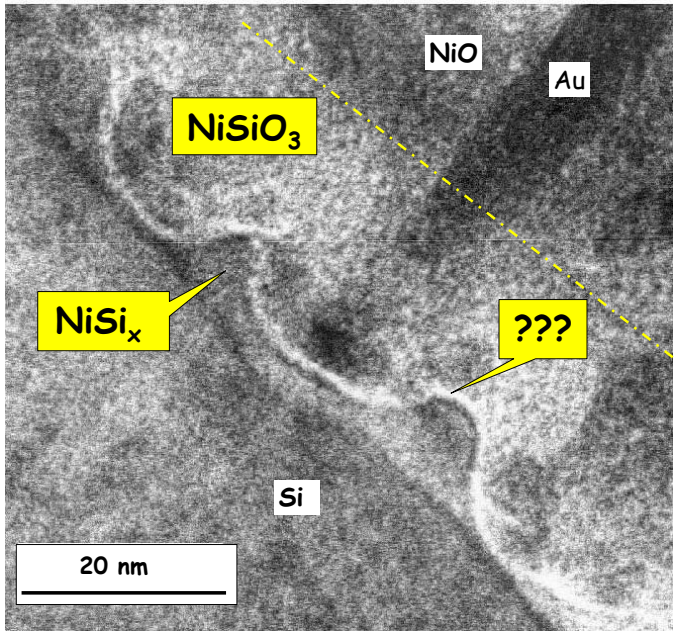
**Analysis:**

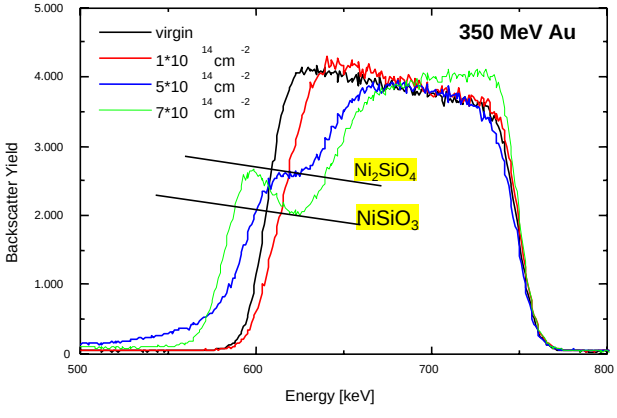
- **RBS**
  Uni Stuttgart, Uni Jena
- **TEM, EFTEM, EDX**
  HMI, Uni Augsburg

## Results

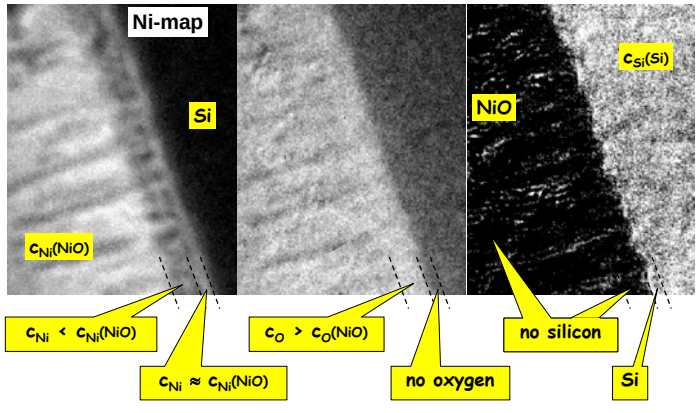
According to RBS and TEM a complex interface structure develops upon irradiation. As can be seen in the TEM-image ($10^{14}$ Au/cm$^2$ at 350 MeV), on top of the subtrate an undulated layer forms, which according to EDX and EFTEM contains only Si and Ni and is thus attributed to a $NiSi_x$-phase also found in RBS ($x \approx 2$). This layer is sharply separated from a region containing Ni ($c_{Ni} < c_{Ni}^{NiO}$), O ($c_O > c_O^{NiO}$) and Si and which according to RBS is attributed to $NiSiO_3$ (lighter area). The nature of the boundary region between these two phases (undulated white line) is not yet clear. Finally, the Silicate is followed by stoichiometric NiO (darker area). The very dark 10 nm wide cylindrical areas in the NiO are due to Au, which has been trapped in the track of the latest ion impacts. It stems from a Au marker layer, which was included to visualize track formation. Remarkably, the troughs in the Silicide are always underneath such tracks, which suggests that the material is pushed to the side as by a stamp. This and the fact that $NiSiO_3$ (and also the spinel $Ni_2SiO_4$ modification) is a high-temperature high pressure phase clearly reflect the extreme non-equilibrium conditions in the excited ion track, which obviously govern the phase formation at the NiO/Si interface.

### Cross Section TEM (XTEM)




Rutherford Backscattering Spectroscopy (RBS)




Energy-Filtered TEM (EFTEM)