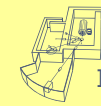


High energy ion beam mixing of oxide ceramics



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Motivation

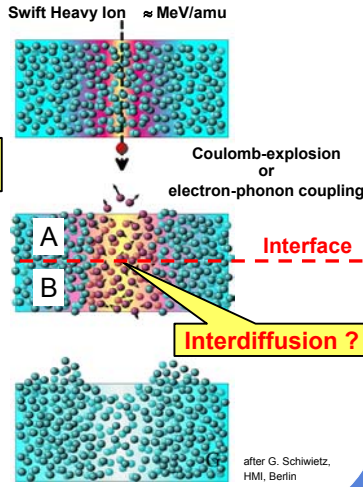
highly excited electronic system

energy transfer to lattice, vivid atomic motion

cylindrical „molten“ zone along the ions path

energy dissipation, rapid solidification, „quenching“

defect-rich or amorphous track $\varnothing \approx 10$ nm



Experiments

(reactive) magnetron sputtering onto thermally oxidized Si-Wafer

≈ 130 nm ≈ 250 nm

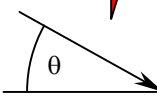
Au 350 MeV
Xe 230 MeV
Kr 260 MeV
Kr 140 MeV
Ar 90 MeV

ZnO	SiO ₂	Si	CuO	SiO ₂	Si
NiO	SiO ₂	Si	Cu ₂ O	SiO ₂	Si
Ni	SiO ₂	Si	Cu	SiO ₂	Si

$\langle S_e \rangle = 6 - 39$ keV/nm

Fluences: $10^{13} - 10^{16}$ cm⁻²

Fluxes: $10^{10} - 10^{11}$ ions cm⁻² s⁻¹

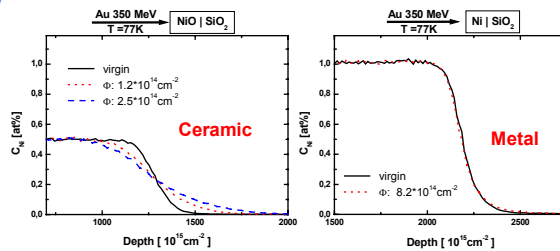


NiO | SiO₂ | Si $\theta = 0^\circ - 85^\circ$

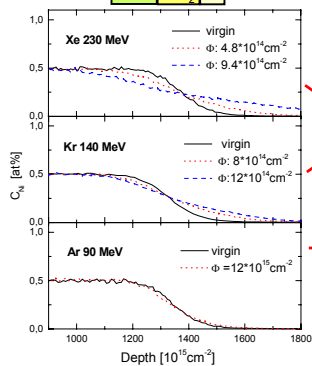
Results

RBS: He⁺ 1 MeV

Concentration Profiles

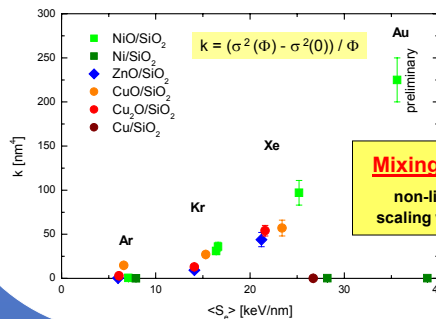


Threshold Effect

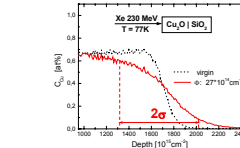


strong intermixing

no effect



Diffusion Constant



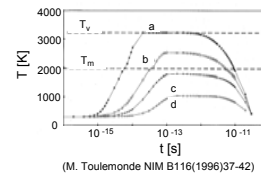
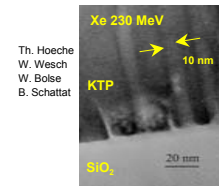
$$k = \Delta \sigma^2 / \Phi$$

Mixing effect of a single ion

$$2D t_t = \Delta \sigma^2 / \Phi \pi r_t^2$$

$D : 10^{-3} - 10^{-4}$ cm²/s

interdiffusion in liquid state



$t_t : 10^{-11}$ s

Anisotropy of Transport

