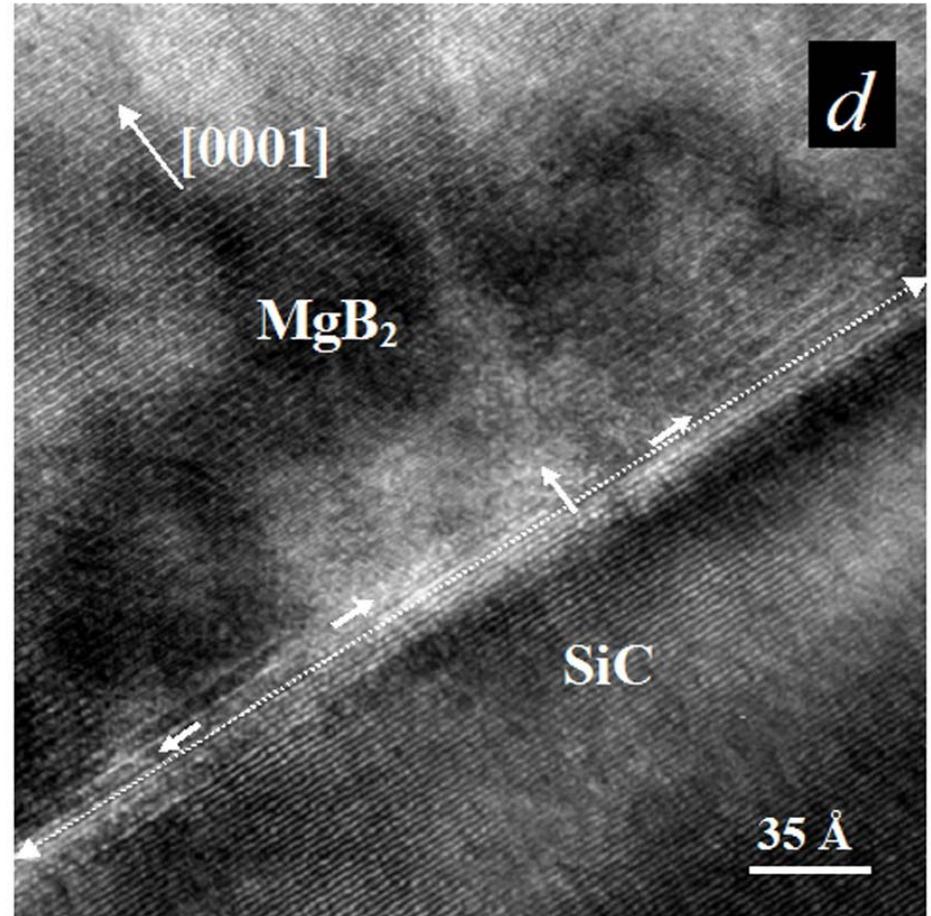


Ordering/Lithography in Glasses/Alloys

John C. Spence Arizona State University DMR 0245702

- The aims of this work include: 1. The fabrication of 5nm metal rings in glass by a new direct-write inorganic electron lithography process. These can be used as "designer dielectrics" or for electronic devices. 2. The study of ordering in silicate glasses by sub-nanometer probe STEM energy-loss near-edge spectroscopy. How are the atoms arranged in a glass, and how does this affect the properties of fiber-optic cables used for communications ? 3. The construction of a dedicated ALCHEMI (X-ray channelling) apparatus. This is used to find the location of dopant atoms in crystals, such as those which improve the performance of the alloys used in aircraft engine turbine alloys.

- The most important recent discovery has been that the superconducting temperature of MgB₂ can be increased by the application of strain. This work, in collaboration with X. Xi and others at U. Pen Physics and W. Pickett at UC Davis, also provides the mechanism for this effect, and has been accepted for publication in Phys Rev Letts.(Sept 04).



High-resolution cross-section TEM image of a 210 nm-thick MgB₂ superconducting film on (0001) SiC taken along the [1100] direction. The atomic structure of the MgB₂/SiC interface can be seen directly, showing misfit dislocations which contribute to the strain in the superconductor. The dotted line indicates the MgB₂/SiC interface and the small arrows show the lattice deformation due to dislocations. Strain increases the superconducting temperature for reasons discussed in Phys Rev Letts (Sept 04).

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Education:

This project involves collaborations with Lawrence Berkeley Lab, the U. Penn high-Tc physics group, and the UC Davis theory group. It supports the education of one Physics PhD student at ASU and a post-doc. Educational activities have included organisation of a teaching school at LBL on electron crystallography (60 students, April 04), a series of introductory lectures on the same subject at an international summer school on electron crystallography in Erice (120 students), Sicily, and maintenance as chair of the Int. Union of Cryst. Commission on Electron Crystallography of their web site. I have rebuilt this specifically to provide resources of free software, books, etc. for new students. Project results are now shown to local high school students at open days of ASU Physics dept.

Outreach:

Our teaching school on nanocrystallography at the national center for electron microscopy in Berkeley (LBL) attracted about 60 students and young researchers to a week of hand-on electron crystallography and image analysis. Spence also taught at a two-week international school in Erice, Sicily on nanocrystallography in summer 04 (below).



Novel Approaches for Structure
Determination of Nanosized Materials
Erice, 9 – 20 June 2004

