UNIVERSITÀ DEGLI STUDI DI MILANO

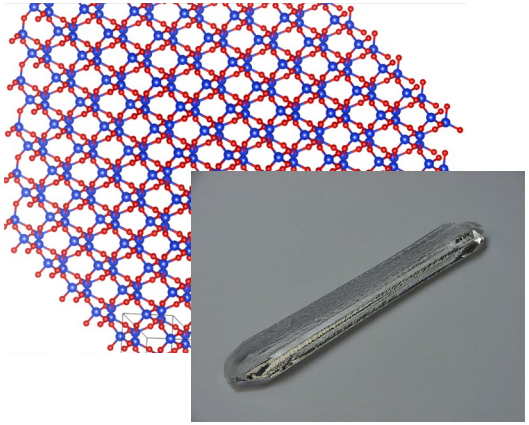
Corso di Dottorato in Scienze della Terra

4-11 July 2022 - Short course (5 cfu, 25 hours) – Room XX

Dipartimento di Scienze della Terra "A. Desio", via Mangiagalli 34, Milano

"Crystal physics and tensor properties of crystals" &
"Synthesis of single crystals and polycrystalline materials in mineralogy"

by Volker KAHLENBERG



PROGRAM

- **Part 1: physical properties described using tensors of rank two, three and four, with practical/technical examples and exercises**
- **Part 2: synthesis of single crystals and methods for synthesizing polycrystalline materials**

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Per informazioni e iscrizione contattare:
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Course description and/or schedule

Crystal physics and tensor properties of crystals
The students will obtain an overview about the basic concepts for dealing with physical properties that have to be described using tensors of rank two, three and four. To deepen the understanding, the theoretical concepts will be applied to examples of practical/technical relevance. Furthermore, exercises will be provided

Day 1 04/07/2022 – 4 hours
Anisotropy; scalars, vectors, tensors; dielectric susceptibility as an example for a second rank tensor; symmetric and anti-symmetric tensors; mathematical description of second rank tensors; transformation behavior of second rank tensors

Day 2 05/07/2022 – 4 hours
Eigenvalues, eigenvectors; relationships between orthonormal and crystallographic coordinate systems; graphical representations of tensors, tensor surfaces; Neumann's principle, influence of symmetry on the tensor components

Day 3 06/07/2022 – 4 hours
Stress tensor; strain tensor; thermal expansion; elastic properties, compliance & stiffness, fourth rank tensors

Day 4 07/07/2022 – 4 hours
Voigt notation; direct inspection; piezoelectricity, third rank tensors; electrostriction; pyroelectricity

Course description and/or schedule

Synthesis of single crystals and polycrystalline materials in mineralogy
The students will obtain an overview about the basic concepts and methods for growing single-crystals or synthesizing polycrystalline materials

Day 5 08/07/2022 – 4 hours
Basics of single-crystal growth, Verneuil technique, melt growth (Czochralski, Bridgman, zone-melting), flux methods, hydrothermal techniques, synthesis from the gas phase

Day 6 11/07/2022 – 5 hours
Solid-state reactions, co-precipitation, sol-gel-technique, solution-combustion-method, mechanochemistry

Total: 25 hours – 5 cfu