Properties of novel materials

Lecturer: Klimczuk Tomasz (WFTiMS PG); 15 h

The course will present principles of various topics of materials. It will start with a general introduction to material science and then will provide basics of thermal, electrical and magnetic properties of materials. After that some, most commonly used synthesis techniques will be presented. Finally, superconductors and thermoelectric materials, the two most important classes of the novel materials, will be discussed in details.

This course is suitable for PhD students in physics, chemistry, engineering and earth science.

1. Introduction (1 hour)
   a. History of material science;
   b. Trends in material science;
   c. Future of material science.

2. Thermal properties of materials (3 hours)
   a. Equipartition of energy;
   b. Heat capacities of solids, liquids and glasses;
   c. Phase stability and phase transitions;
   d. The order of phase transition
   e. Thermal expansion;
   f. Thermal conductivity of gases, solids and metals;
   g. Binary phase diagrams, the lever principle;
   h. Ternary phase diagrams.

3. Electrical properties of matter (1 hour)
   a. Metals, insulators, semiconductors;
   b. Temperature dependence of electrical conductivity.

4. Magnetic properties of matter (2 hours)
   a. Paramagnetic, diamagnetic and ferromagnetic materials;
   b. Superparamagnetism;
   c. Temperature dependence of magnetization;
   d. Curie Weiss law;
   e. Arrot plot.

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5. Synthesis methods in solid state chemistry (2 hours)
    a. Synthesis of polycrystalline materials;
    b. Crystal growth techniques.

6. Thermoelectricity and thermoelectric materials (2 hours)

7. Superconductivity and superconducting materials (3 hours)
    a. Superconducting elements;
    b. Superconducting alloys;
    c. High temperature superconductors;
    d. Non-centrosymmetric, heavy fermion superconducting compounds.

8. Selected topics of X-ray and neutron techniques in solid state chemistry (1 hour).

TERMINY WYKŁADÓW			
Data	**Dzień tygodnia**	**Godzina**	**Sala**
2013-04-10	środa	15.00	Bud. Nano 3/09
2013-04-11	czwartek	15.00	Bud. Nano 3/07
2013-04-17	środa	15.00	Bud. Nano 3/09
2013-04-18	czwartek	15.00	Bud. Nano 3/07
2013-04-24	środa	15.00	Bud. Nano 3/09
2013-04-25	czwartek	15.00	Bud. Nano 3/07
2013-05-08	środa	15.00	Bud. Nano 3/09
2013-05-09	czwartek	15.00	Bud. Nano 3/07
2013-05-15	środa	15.00	Bud. Nano 3/09
2013-05-16	czwartek	15.00	Bud. Nano 3/07
2013-05-22	środa	15.00	Bud. Nano 3/09
2013-05-23	czwartek	15.00	Bud. Nano 3/07
2013-06-05	środa	15.00	Bud. Nano 3/09
2013-06-06	czwartek	15.00	Bud. Nano 3/07
2013-06-12	środa	15.00	Bud. Nano 3/09

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