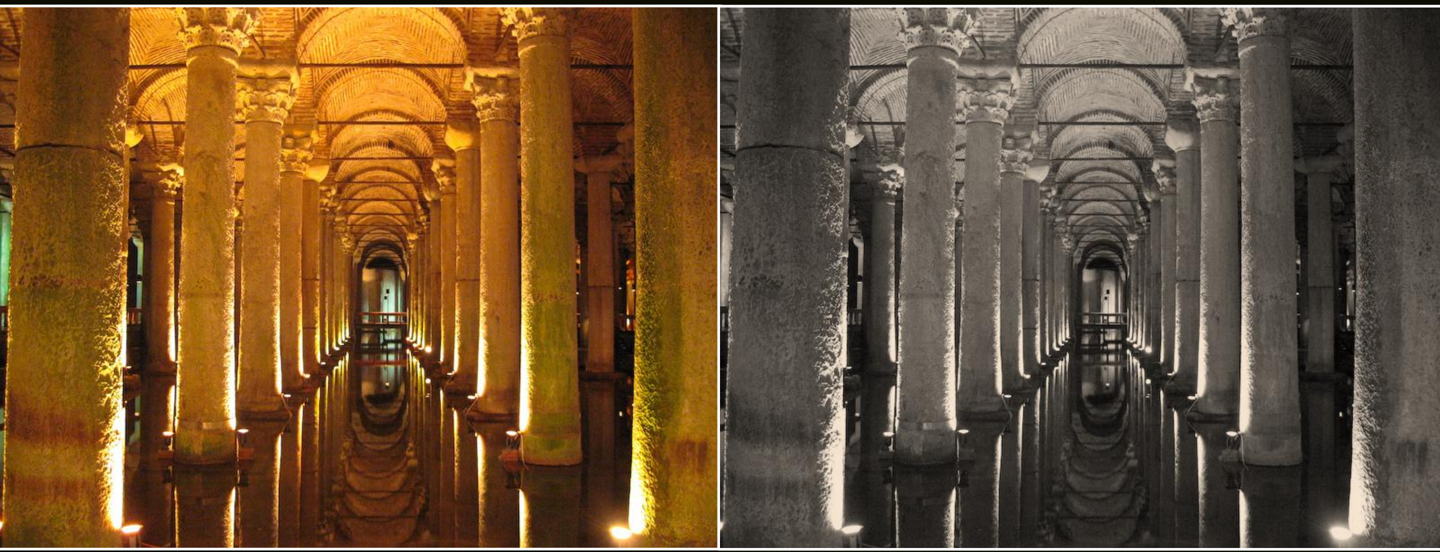
24-25 JUNE 2012 • ISTANBUL, TURKEY



NANOSIZED- and NANO-STRUCTURED MATERIALS: FUNDAMENTALS AND APPLICATIONS

INSTRUCTOR:
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C O U R S E   C O N T E N T S

COURSE CONTENTS:

1. Introduction and short overview

2. Properties of Nano-Sized and Nano-Structured Materials when approaching the molecular size

- Thermodynamics properties vs. crystallite size;
- Localization phenomena (electrons & phonons), crystallite size and separation;
- Learning from the nature:
  - super-hydrophobic, self-cleaning surfaces;
  - "lotus effect" upside down;
  - super-adhesive surfaces;
  - design of high-specific strength & toughness;
  - design of colors;

3. Structural bulk Nanocomposites:

- Graphite fibres carbon composites with high specific strength
- Polymer-based nanocomposites reinforced by inorganic fillers
- Future trends: carbon nanotube reinforced nanocomposites

4. Functional Nano-structured coatings for machine parts

- The role of the ratio of elastic modulus to hardness for wear of machine parts;
- Self-lubricant hard nanocomposites for harsh and variable environment (humid-dry, low-high temperature etc.);

5. Hard and wear-resistant coatings for tools

- Introduction: The recent search for super- and ultrahard materials: Go Nano!
- Why coatings on tools ?
- Transition Metal Nitrides, Carbides & Borides
- Oxide Coatings
- Diamond and Diamond-Like Carbon – Based Coatings

6. Hard and Superhard Nanocomposites with high thermal stability and oxidation resistance for machining (drilling, milling, turning, forming, stamping) and other applications.

6.1. Different approaches to superhard coatings, their advantages and drawbacks:
- Intrinsically superhard materials
- Hardening by energetic ion bombardment
- Superhard Heterostructures
- Superhad nanocomposites by phase segregation: Design concept, their preparation, properties and recent progress in their understanding.

6.2. Industrial applications of hard and superhard nanocomposites in comparison to other advanced coatings including polycrystalline diamond.

6.3. The presently available hard and superhard coatings can still be significantly improved

7. Summary and Conclusions

Only if the time will allow within two days (may be included into the introduction):

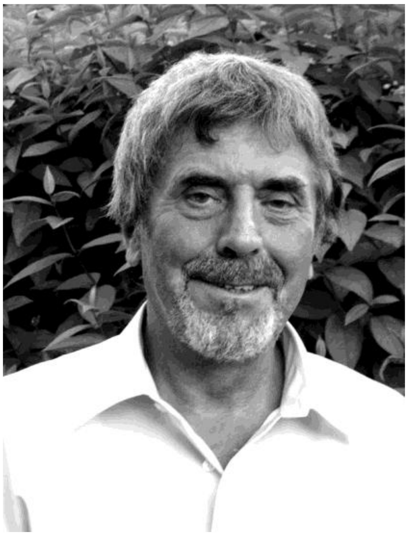
i) Some aspects of the preparation of nano-structured materials with focus on industrial applications

- Fundamentals of Chemical and Physical Vapour Deposition of Thin Coatings (Thermodynamics & Kinetics, Thermal CVD vs. plasma induced CVD; effect of substrate bias on the properties of coatings; applied bias and self-bias in D.C. and R.F. glow discharges, effect of frequency; problems of scaling of deposition processes);
- Miscellaneous techniques;

ii) Characterization

- Determination of crystallite size by XRD and by TEM;
- Determination of internal stress in thin films;
- X-ray photoelectron and Auger electron spectroscopy (XPS & AES);
- Ions Scattering Spectroscopy (ISS), Rutherford Backscattering (RBS) and Elastic Recoil Detection (ERB);
- Sensitivity vs. Dynamic Range → determination of light impurities;
- Scanning Tunnelling and Atomic Force Microscopy (STM & AFM) – morphology & electronic properties;
- The meaning of hardness and its correct measurement
- Miscellaneous (e.g. optoelectronic properties etc., depending on the available time)

ABOUT THE COURSE INSTRUCTOR: PROFESSOR STAN VEPREK



After his initial research work in plasma diagnostics and spectroscopy, Stan Veprek began his work on the deposition of thin films by means of plasma CVD 40 years ago at the Institute of Physics of the Czech Academy of Science where he started his scientific career after an education as a high school teacher (in Ceske Budejovice) followed by the study of physics at the Charles University in Prague (graduated 1962). His first major result was the deposition of nanocrystalline silicon, nc-Si, by means of chemical transport in plasma (published in 1968; nowadays, nc-Si is an important material for large-scale microelectronics, flat panel displays and thin films solar cells). He became involved in the research of the plasma-wall interactions in nuclear fusion devices. In 1976 he proposed the protective coating of the inner wall with boron carbide, and in the following years developed "boronization" by means of plasma CVD, which found successful application in several large fusion devices around the world.

His continuing interest in nc-Si resulted in, among others, classical papers on Raman scattering. Together with the Swiss national museum he developed a new plasma-chemical method for the restoration and conservation of archeological metallic artifacts.

ABOUT THE INSTRUCTOR

In 1988 he was appointed full Professor and head of the Institute for Chemistry of Inorganic Materials at the Technical University of Munich, where he continued his research on a- and nc-Si, organometallic CVD, heteroepitaxy of 3C-SiC and others. Here, also the design principle for superhard materials was born in 1995. In this field, he continued his collaboration with Prof. Li Shizhi (Qingdao University of Science and Technology, China) and begun a collaboration with a Czech company SHM, which pioneered the industrialization of superhard nanocomposites coatings based on his design concept.

His latest work focuses on the understanding of the formation of the superhard nanocomposites by spinodal phase segregation and of their mechanical properties by means of combined ab intio DFT and thermodynamics studies (collaboration with Dr. R. F. Zhang (visiting scientist at TUM), Prof. A.S. Argon and D. M. Parks (Massachusetts Inst. of Technol. and other colleagues).

Stan has published 368 papers and several book-chapters. The most recent book co-authored with Prof. C. Koch, I. Ovidko and S. Seal "Structural Nanocrystalline Materials" (Cambridge University Press 2007). He is co-editor of Plasma Chemistry and Plasma Processing, and has co-organized various conferences and sessions at ISPC, MRS, ICMCTF and others, and served on several IUPAC and Int. Union of Vacuum Societies committees.

He received the Silver Medal of the Societe d'Encouragement Pour la Recherche et l'Invention, Paris (1979), Silver Medal of the Masaryk University Brno (1991), Honorary Doctorate (Dr. h.c.) from the Masaryk University Brno, Czech Republic (1999), the Blaise Pascal Medal of the European Academy of Sciences (2004) and the AVS John Thornton Memorial Award of the American Vacuum Society (2005). In 2003 he was appointed foreign member of the Commission I of Low-Temperature Plasma Chemistry, Polish Academy of Sciences, Branch Lublin.

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DSL / ACEX PARTICIPANTS: 350, EUR(*)
(*) UNTIL 15 MARCH, 2012

AFTER: 980, EUR (REGULAR REGISTARTION)
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Registration includes:
- ✓ 2 Full Days Course,
- ✓ Printed Course Materials, in Book Format
- ✓ Course Certificate,
- ✓ 2 Refreshments Daily,
- ✓ Lunch at Hotel Venue (Daily / 2 Days)

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NOTE: THIS COURSE IS LIMITED TO A SMALL NUMBER OF PARTICIPANTS, RESERVE YOUR PLACE SOON!

IRONIX - CONTINUING EDUCATION:
NANOSIZED- and NANO-STRUCTURED MATERIALS:
FUNDAMENTALS AND APPLICATIONS
24-25 June, 2012
Istanbul, Turkey

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