Research interests
Summer school on "microstructure evolution and dynamics"
at the Center for Mathematical Sciences,
Technion, Haifa, Israel, August 2013

Amram Dor
Material Science
Technion
Israel

I am interested in the thermodynamics and kinetics of phase transformations in alloyed, metallic micro- and nano-particles, with an emphasis on the effect of the various interfaces in the system on microstructure evolution and phase stability.

Aizenshtein Michael
NRCN, Israel

Microstructure modelling

Lior Atia
Mechanical Engineering
Technion
Israel

Our research focuses on biological membranes, in equilibrium and non-equilibrium configurations. The biological membrane protect the biological cell by providing a barrier, but also controls almost all interaction of cells with their surroundings. A key to this diverse functionality is the coupling between mechanics and biochemical events and the rich phenomena that this coupling creates. Mechanical 'signals' carried by the biological membrane (stresses, deformations, shape) precondition the onset of many biochemical events in the cell, and have an important role in controlling and regulating cell biochemistry.

Some of those biochemical events are presented by the lipid and protein molecules acting as an essential membrane bricks. Those exhibits interesting and unique phase separation phenomena, which are typically modelled with the aid of revised Chan-Hilliard and Ginzburg-Landau formalism.

Avi Aminov
Physics
Technion, Israel

Transport systems out of equilibrium

Dr. Shaul Avraham
NRCN, Israel

I am interested in various aspects of solidification: Nucleation, grain growth and solidification defects

Koby Barkan
Physics
Tel Aviv University, Israel

I am interested in the self assembly and dynamics of soft-matter systems that form unique phases such as Quasicrystals or periodic crystals with a non-trivial diffraction pattern.

Yaron Ben-Shmuel
Rafael, Israel

Modeling Plasticity by Non-Continuous Deformation: Plastic deformation is strongly related to the microstructure. Well known phenomenon such as strain hardening and Bauschinger effect are still treated on the continuum basis. The lack of direct correlation between macro parameters and their micro processes makes it seem impossible that continuum theories can offer a physical interpretation for those complexities. Nevertheless, additional terms can reflect micro processes by second-order statistical quantities (point correlations) such as Reynolds stress tensor in Reynolds-averaged Navier-Stokes (RANS) equations (McDonough, 2007). Unfortunately this approach has not been materialized for solids.

Sagi Chen
Mechanical Engineering
Technion, Israel

The Dependence of Mechanical Properties on the Nanograins Distribution in HCP Metals.
In recent experiments, it was found that failure occurs during an athermal process phase. In particular, the deformed microstructure of Ti and Mg alloys revealed the emergence of dynamically recrystallized nanograins prior to adiabatic shear bands

formation. Molecular Dynamics (MD) simulations are employed to perform tensile and shear simulations in order to relate the microstructural evolution to stress-strain curves and explore the sequence by which dynamic recrystallization can coalesce into a fully developed shear band."

Keren Delmar
The Norman Seiden Multidisciplinary Graduate program in Nanoscience & Nanotechnology
Chemical Engineering
Technion, Israel

Controlled Release of Hydrophobic Drugs from Nanocarriers Embedded in Hydrogels My goal is to design a system that will help tackle the challenge of delivering hydrophobic drugs, and investigate its structure and its properties. The system is comprised of two sub-systems: Oil in water microemulsion that will enhance the drugs' solubility in water and a chitosan hydrogel that will act as a drug delivery vehicle.
Under the supervision of Prof. Havazelet Bianco Peled.

Vadim Derkach
Mathematics
Technion, Israel

My work focuses on the numerical simulation and analysis of grain boundary migration in an idealized 3D systems of three grains embedded in a thin film. I consider the motion of the grain boundaries and the exterior surfaces which couple along thermal groove. This allow me to study the effect of processes such as external surface evolution and thermal groove formation, on grain boundary migration.

Dr. Matt Elsey
Mathematics
Courant institute
NYC, USA

I study numerical algorithms for simulating curvature-driven evolutions of networks of interfaces. These flows arise in models of polycrystalline grain growth. I am interested in designing and implementing highly accurate and efficient algorithms with the potential for upscaling to very large ($> 10^6$) systems of grains. I also am interested in image processing-type applications in materials science; for instance, in automatically detecting and characterizing isolated dislocations and grain boundaries in images of almost-periodic media.

Philipp Engels
Interdisciplinary centre for advanced material simulations (ICAMS)
Ruhr-University Bochum
Germany

During the deformation of multiphase metallic polycrystalline materials the phase transformation kinetics and the nucleation process are strongly influenced by not only the local elastic deformation but also the local and non-local plastic deformation. Thus, this project's goal is to incorporate crystal plasticity algorithms in a multi-phase-field framework ("OpenPhase") in order to describe the aforementioned coupling. The main challenges that arise are the appropriate treatment of (large) deformations in the existing phase-field approach, the choice of mechanical interpolation schemes and the understanding of micromechanical mechanisms in the vicinity of the moving interface.

Dr. Eilon Faran
Mechanical Engineering
Technion, Israel

Kinetics of twin boundaries in active materials, such as FSMA, SMA, ferroelectrics and ferroic ceramics. Study is focused on experimental investigation at the level of individual interfaces accompanied by basic analytic modeling. Such work enables the extraction of kinetic relations for twin boundary motion as well as identification and characterization of the dominant energy barriers that determine these relations.

Ofer Filiba
Environmental physics and solar energy
Ben Gurion Universiry, Israel

Interaction between heterogeneously charged surfaces in dilute and concentrated electrolytes.

Prof. Viatcheslav Freger
Chemical Engineering
Technion, Israel

My research focuses on polymeric membranes for water purification (e.g., desalination) and electrochemical processes (e.g., fuel cells) and on physicochemical mechanisms involved in these processes. Equilibrium and transport phenomena considered in the workshop are of direct relevance to my research.

Dr. Michael Gelantalis
Mathematics
RWTH Aachen University, Germany

I am interested in topics like nonlinear PDE's, the Calculus of Variations, Ginzburg-Landau vortices, and lately in dynamic metastability/slow coarsening.

Emanuelle Goren
RBNI-Nano Program
Chemical Engineering
Technion, Israel

Preparation, application and characterization of a ReRAM type nonvolatile memory device based on thin layers of polycrystalline titania.

Dr. Yanqiu Guo
Applied Mathematics
Weizmann Institute, Israel

I am interested in analysis of partial differential equations, in particular, nonlinear wave equations. I have been working on well-posedness, blow-up, regularities, and long-time behaviors of solutions.

Eyal Hollander
Mechanical Engineering
Technion ,Israel

My research is concentrated on the study of the theoretical modeling of Optomechanical resonators, nonlinear vibrations and chaotic behavior. I'm also familiar with Optical and Optomechanical Design of micro and nano opto-electro-mechanical systems.

Dr. Li Jinkai
Department of Mathematics
The Chinese University of Hong Kong
China
and Weizmann institute

My research interest lies in some kinds of partial differential equations deriving from fluid dynamics, including the Navier-Stokes equations, Magnetohydrodynamics (MHD for short) and the liquid crystal equations. I am specially interested in the weak or strong solutions to the full Ericksen-Leslie system, which describing the evolution of nematic liquid crystals. The full Ericksen-Leslie system reads as

$$\begin{aligned}
&\partial_t u^i + u\cdot\nabla u^i - \Delta u^i + \partial_i p = \\
&-\partial_j(\partial_i d^k W_{p_j^k}(d,\nabla d)),\\
&\mathrm{div} u = 0,\\
&\partial_t d^i + u\cdot\nabla d^i = \\
&\partial_\alpha(W_{p_\alpha^i}(d,\nabla d)) - W_{d^i}(d,\nabla d) - \\
&(\partial_\alpha(W_{p_\alpha^k}(d,\nabla d)) - W_{d^k}(d,\nabla d))d^k d^i,
\end{aligned}$$

where the Oseen-Frank density $W(d,\nabla d)$ is of the form

$$W(d,\nabla d) = k_1(\mathrm{div} d)^2 + k_2(d\cdot\mathrm{curl} d)^2 + k_3|d\times\mathrm{curl} d|^2.$$

Dima Kalaev
Physics
Technion,Israel

Properties of Solid State Devices Based on Mixed Ionic Electronic Conductors

Oleg Kelis
Mathematics
Ort Bruade, Israel

My research interests are pseudodifferential operators in particular parameter elliptic and parabolic multi order systems. In addition, applied mathematics with Maple, in particular Kelvin Helmholtz instability model in adiabatic viscid jet.

Olga Kleinerman
Chemical Engineering
Technion,Israel

During recent years it was demonstrated, that ultra long CNTs spontaneously dissolve in chlorosulfonic acid, and at high concentrations form a liquid

crystalline phase. This discovery lays the foundation for fiber spinning from solutions high quality ultra-long carbon nanotubes.

The transition between the isotropic and liquid crystalline (nematic) phases is strongly dependent of CNT type, concentration, and solvent strength. My research is focused on a study of liquid-crystalline phase development and its arrangement at the nano-scale in CNT/chlorosulforic acid solutions, starting from diluted solutions up to concentrated liquid-crystalline CNT phases, used as a "dope" for fiber spinning , by using cryogenic transmission and cryogenic scanning- electron microscopy (cryo-TEM and cryo-SEM).
Study of CNT behavior in super-acid solution in whole concentration range, combined with HR-SEM imaging and X-ray analysis of spun fibers, solely consisting of CNTS, provides important information to our understanding of factors affecting fiber final properties.

Gabriel Path
Mathematical Institute
Charles University in Prague
Czech Republic

Currently I am working on my PhD thesis entitled 'Mathematical modelling of thin films of martensitic materials' at the Charles University in Prague, Czech Republic. A broader circle of my scientific interests includes parameterized measures and relaxation techniques in the calculus of variations, mathematical and numerical modelling of shape-memory alloys, scale transitions and thermodynamics in mechanics of solids.

Maor Ronen
RBNI-Nano Program
Chemical engineering
Technion, Israel

My research focuses on characterization of complexes formed by cationic lipid and oppositely charged polyelectrolytes using cryogenic microscopy. The study tries to demonstrate the structural changes on the nano-level as the charge ratio between a polyelectrolyte and a cationic lipid changed. Charge ratio is the ratio between the negatively charged groups of the polymer and the positively charged groups of the lipids in a solution. These complexes have the potential to be utilized for innovative applications in nano-medicine and nanobiotechnology (e.g. Gene-Therapy).

Yonatan Rotbaum
Mechanical Engineering
Technion, Israel

Dynamic tensile necking: influence of geometrical imperfections.
Study experimentally and numerically the effect of imperfections on tensile specimens subjected to high strain rate tensile loading, in an attempt to predict the failure time and neck position associated with an imperfections depth and geometry.

Koren Shreiber
nano mechanics simulation group
Mechanical Engineering
Technion, Israel

M.Sc. Research plan: "Modeling the Strength of Ni3Al Nanocubes Using Molecular Dynamics Simulations"
We propose to perform a molecular dynamics study, to obtain insights on the mechanisms which dominate the deformation of Ni3Al nanocubes.
Guidance: Dr. Dan Mordehai

Ory Schnitzer
Mathematics
Technion, Israel

Fluid Mechanics, Electrokinetic phenomena.

Elad Tenenbaum
Mechanical Engineering
Technion, Israel

Our research focuses on biological membranes, in equilibrium and non-equilibrium configurations. The biological membrane protect the biological cell by providing a barrier, but also controls almost all interaction of cells with their surroundings. A key to this diverse functionality is the coupling between mechanics and biochemical events and the rich phenomena that this coupling creates. Mechanical 'signals' carried by the biological membrane (stresses, deformations, shape) precondition the onset of many biochemical events in the cell, and have an important role in controlling and regulating cell biochemistry.

Some of those biochemical events are presented by the lipid and protein molecules acting as an essential membrane bricks. Those exhibits interesting and unique phase separation phenomena, which are typically modelled with the aid of revised Chan-Hilliard and Ginzburg-Landau formalism.

Heidrun Thaler
Institute for advanced materials
Karlsruhe Institute of Technology
Karlsruhe, Germany

The scope of my PhD project is devoted to extensive computational studies of pseudo-binary NiAl-Mo and NiAl-Cr (NiAl-X) alloys based on the phase-field method in order to explore large-scale 3D eutectic pattern formations. The aim is to simulate the evolution of experimentally reported well-aligned rod-like microstructures in NiAl-X eutectics under the conditions of directional solidification in 3D. To set up the parameters for the phase-field simulations, thermodynamic data and free energies for the pseudo-binary systems shall be used. Interfacial properties such as e.g. the interfacial energies, kinetics and anisotropies of the solid-liquid and solid-solid boundaries are taken from literature. In simulation studies, the variation of temperature gradients, growth rates and composition shall be considered to analyze the corresponding microstructures with respect to the resulting type of morphology (ordering of rods) and volume fraction of phases, the spacing between Mo fibres, the size of the fibres and the formation of grain boundaries in ensembles with different fibre orientations. The simulated structures shall be compared with experimentally observed micrographs.

Patrick VanMeurs
Mathematics
Eindhoven U. of Techniology
Netherlands

My research is about the upscaling of a one dimensional particle system, which is a highly simplified model to describe dislocations in metals. The unknowns in this particle system are the positions of the particles. The particles exert a repelling force on each other, while they are kept together by impenetrable boundaries or an external force. The main difficulty for the upscaling is in the interaction of the particles, which is unbounded and non-local.

Vardanyan Vardan
Department of Solar Energy and Environmental Physics
Ben Gurion University, Israel

Electroconvective mechanisms in concentration polarization, Electrodiffusion of ions.

Patrcia Vasconcelos
GRIDS Simulation Software Research and Development Group
The Department of Mechanical Engineering
University of Aveiro in Portugal

My research interests focus on the development of a phase field model for multiphase steels, and coupling numerical techniques elements concerning the study of thermomechanical behavior of these materials

Dr. Arkady Vilenkin
Racah Institute of Physics
Hebrew University
Israel

Surfaces and interfaces dynamics in macroscopic time and space scales, large fluctuations in non–equilibrium systems.

Dr. Arik Yochelis
Department of Solar Energy and Environmental Physics
Ben Gurion University, Israel

My group focuses on (i) basic theory of pattern forming systems and (ii) applications related to non-equilibrium charge dynamics: coupling between electronic and ionic flows, relation of electrode reactions to charge densities within the electrolyte (electrical diffuse layers), and impact of structure properties of organic media on degradation. Although the emphasize is on dynamical systems and pattern formation we seek distinct physico-chemical models that are often derived via empirical electrochemical studies (in house).

Anna Zigelman
Mathematics
Technion, Israel

My research concentrates on the grain boundary migration in bicrystal, where the exterior surface evolves by surface diffusion.