Nanoscale Origins of Plasticity in Modern Nanostructured Materials: a COST MecaNano Minisymposia

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ABSTRACT

Our society urgently needs new materials with improved performance and durability in order to overcome the environmental crisis. Room for significant progress is available at the nano-scale, where most of properties originate. Research at this length scale has strongly intensified over the past two decades, but the knowledge remains very fragmented, so that a holistic understanding of how the nanoscale mechanical behavior gives rise to the macroscopic properties of the materials is still missing. Towards this goal, the European Cooperation in Science & Technology (COST) Action CA21121 MecaNano was established in 2022 (running until 2026).

MecaNano stands for "European Network for the Mechanics of Matter at the Nano-Scale". The Action is intended as a broad international cooperation aiming to advance the multiscale understanding of the mechanical behavior of nanostructured materials, with an eye to pave the way for the development of new modern materials. By combining the expertise of its participants – from experimentalists to simulation, data management and machine learning experts – it aims to overcome the different bottlenecks limiting the exploration of mechanical size effects. Synergetic gains will be achieved through a common agreement on the physical parameters to be investigated and by promoting interoperability of the research data.

In the spirit of MecaNano COST Action, this Minisymposia aims at illuminating the challenges in modelling plasticity in modern nanostructured materials, and in particular:

- Identify and understand size effects and characteristic length scales,
- discuss simulation challenges to promote the use of the most effective (robustness, highest throughput) techniques.

Simulation technics of interest include, but are not limited to:

- Atomistic (Ab initio and classical potential),
- Continuum/Discrete Dislocation Dynamics,

- Phase field, FFT-based approaches
- Multiscale approaches,
- Machine learning / data-driven approaches.