Mesoscale Priority Research Direction

The nexus of synthetic biology and material science at the mesoscale

Opportunity

By hijacking the exquisite organizational attributes of natural systems, it will be possible to develop new classes of materials with structural and functional features that require meso-scale organization.

Examples in nature include the control of energy transfer in respiration and photosynthesis, and cell wall synthesis in plants.

Meso Challenge

To exploit our understanding of the natural systems to develop mesoscale synthetic architectures.
In natural metabolic processes individual reactions are carried out by nanoscale architectures while efficiency is dictated by synergy and organization at the mesoscale.

Approach

An integrated vision that encompasses advances in *synthetic biology* and *advanced materials syntheses*

Microscopies, spectroscopies, and x-ray and neutron scattering techniques, to provide structural and dynamic information across multiple time and length scales

Computational approaches to model structural complexity and hierarchy expected in mesoscale systems

Impact

The fundamental science proposed in this grand challenge will result in paradigm shift in materials research. It will impact the development of new classes of materials which are unattainable using current synthetic approaches.

It's success will be felt in many areas including high performance materials and systems for energy/ automotive/ aerospace applications, biomedical, etc.

References: M.B. Cardoso, D. Smolensky, W.T. Heller, K.Hong, H.O'Neill (2011) *Energy and Environmental Science,* **4**: 181-188

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