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**Towards nanomaterials engineering for solar energy harvesting and conversion**

**Abstract:** The inherent increasing demand in clean energy solutions and new technologies has prompted scientists to custom the materials design and properties for targeted application. Most of the emerging materials such as 0D, 1D and 2D materials that demonstrate promising properties, are complex with more and more reduced dimensions. Special fabrication techniques as well as advanced multiscale characterization in conjunction with modelling, have emerged to make the processing of these materials possible and easily tuneable to meet the targeted application. In this talk, examples of nanoengineered materials exhibiting high optical performances that can serve as high-yield photocatalysts for solar energy harvesting will be tackled with special emphasis to the physics underlaying their performances.