

CONDENSED MATTER PHYSICS SEMINAR

Thursday 11 June at 14:30

Simpkins Lee Seminar Room, Department of Physics

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Connecting Mechanical Properties, Durability, and Reliability of Metal-Halide Perovskite Solar Cells

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Renewable electricity from solar photovoltaics (PV), combined with low-cost large-scale storage, is likely to play a dominant role in decarbonizing the expanding global power sector in the long run. For example, the global deployment of PV is targeted at ~ 75 TW installed capacity by 2050, from the current (2024) ~ 2 TW. While currently used PV technologies are efficient, reliable, and relatively cheap, there is, and always will be, insatiable demand for new PV technologies that are more efficient and cost-effective, and importantly, have a smaller 'carbon-footprint.' In this context, the promising new perovskite solar cells (PSCs) technology, where the thin-film PV can be mechanically rigid or flexible, has the potential to meet all those requirements. Also, lightweight flexible PSCs are more versatile, where they can be used to power internet-of-things, vehicles, satellites, portable supplies, etc. While the record power-conversion efficiency of PSCs now rivals that of conventional silicon PV, durability and mechanical reliability are becoming 'bottleneck' challenges in PSCs. To address these technical hurdles, several rationally-designed interfacial tailoring approaches are used to enhance the mechanical properties of both rigid PSCs and flexible PSCs. Most importantly, these approaches are designed such that they simultaneously increase both efficiency and durability of PSCs. The important challenges and opportunities, together with best practices, pertaining to the three key interrelated elements that determine the mechanical reliability of PSCs are discussed: (i) driving stresses, (ii) mechanical properties, and (iii) mechanical failure. The scientific rationales for these approaches to improve the mechanical properties are also discussed, together with the presentation of examples where failure-mitigation results in more efficient, durable, and reliable PSCs.

Host: Professor Nakita K. Noel