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## ABSTRACT:

### Structure & Dynamics in Sustainable Energy Materials: The Crucial Role of Large-Scale Facilities

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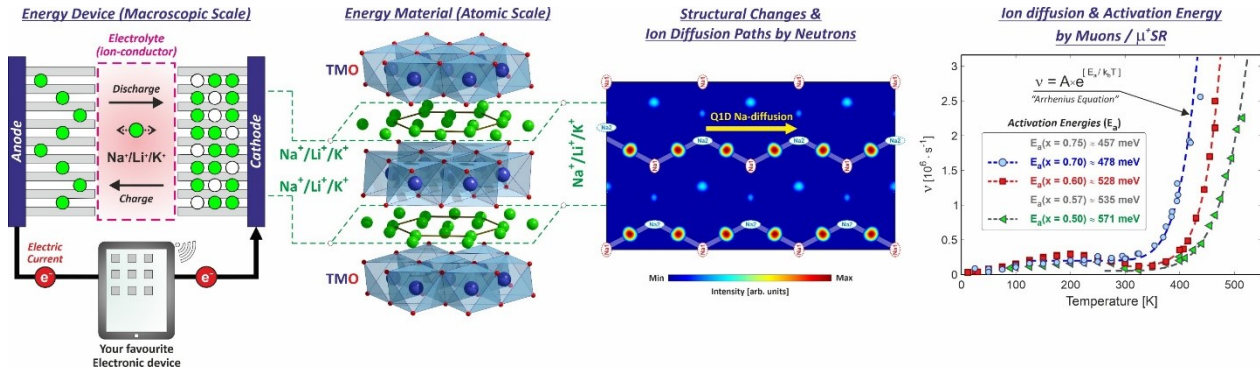
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Establishing a sustainable society is our century's grand challenge. Here, one of the main obstacles is how to efficiently harvest, store and utilize green energy. To facilitate such transition new generations of advanced functional energy and quantum materials needs to be developed. This includes understanding and controlling material properties on an atomic, or even subatomic, length-scale. Only recently, technological advancement in materials synthesis and characterization techniques have opened new possibilities for studying both structural and dynamic material properties on the length- and time-scales necessary for advancing the field. Here a new generation of large-scale research infrastructures with more powerful neutron, x-ray and muon sources have played an important role. This state-of-the-art research landscape is the main platform for the SMaRT research group at the KTH Royal Institute of Technology. We run a comprehensive scientific program for advanced development of sustainable energy materials as well as novel quantum materials, studied mainly by large-scale techniques [1].

In this talk I will give the general background as well as a few examples that show that neutron scattering, and complementary techniques are both crucial and optimal techniques for advancing this important field. I will show our recent work on Li-/Na-/K-ion battery materials that reveal new possibilities to improve battery performance using strain/pressure as well as surface coating [2-6]. I will further show how in-operando measurements of porous carbon reveal novel insight into the synergy effect between structure and dynamics in H-storage materials [7-10]. Finally, I will showcase our more fundamental efforts into organic quantum materials that could be a key development towards future energy efficient information and communication technologies [11].

In summary, I aim to show that our current research program has established an innovative and detailed insight into the atomic structure and ion-diffusion mechanisms, as well as their synergy. This now allow us to actively consider tuning of future energy related materials with improved functional properties. In our quest, the use of neutron scattering has clearly been a crucial component. To support

continuous breakthroughs for science and technology, Sweden and Europe are currently making unprecedented investments with the development and construction of the European Spallation Source (ESS) [12]. We are in parallel also building the next generation of neutron users/experts within the Swedish national graduate school in neutron scattering (SwedNess) [13].



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