Earth Abundant Thin-Film Solar Cells as a Sustainable Solar Energy Pathway

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Problem Statement

• Earth Abundant Thin-Film Solar Cells as a Sustainable Solar Energy Pathway
  – Why is this important? - Over 30 terawatts \((10^{12} \text{ W})\) of new power will be needed globally by 2050
  – Why is it hard? Must be sustainable - environmental, social, behavioral, economic
  – Broader impacts of the problem: Realizing economically viable, environmentally benign, earth-abundant solar cells
  – Societal, behavioral, economic impact: Develop an understanding of environmental, societal, and economic issues
Research

• Key aspects of research objectives and intellectual merit:

**Thrust 1:** Scientific and technology innovation in earth-abundant, thin-film solar cells: Bulk homo junction and HHDJ concepts; FeS$_2$, Cu$_x$S, Zn$_3$P$_2$, CZTS

**Thrust 2:** Sustainability assessment of the new technology and products: life cycle sustainability assessments (LCSA) of viable environmental, economic, and sociopolitical (EES) measures
Research

• Results to date

**Thrust 1:** (1) Systems for materials synthesis and device fabrication have been set up

(2) Nanostructure materials and thin-films of FeS$_2$, Cu$_x$S, Zn$_3$P$_2$, CZTS have been synthesized.

**Thrust 2:** (1) Domestic analysis on key elements has been performed.

(2) LCA analysis of common solar cell technologies has been started.

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Research

• Any roadblocks encountered

Variables for environmental, societal, and economic issues are difficult to define
Multidisciplinary Aspect

• Explain the mode of multidisciplinary collaboration within the project team

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Multidisciplinary Aspect

- Explain how is the SBE (environmental, social, behavioral, economic) aspect of the work is enhancing the research

**Thrust 2** will provide critical feedback for **Thrust 1** to improve the solar cell systems and processes from the sustainability point of view.
Multidisciplinary Aspect

• Remaining tasks
  • Scientific
  • Educational, training and outreach

Education: k-12 students and teachers, graduate and undergraduate students

Public awareness: Conferences, seminar, activities

Tech transfer and workforce training: Industrial partners

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