

Emerging Issues for Photovoltaic (PV) Modules: Surface Soiling and Fundamental Photon Coupling

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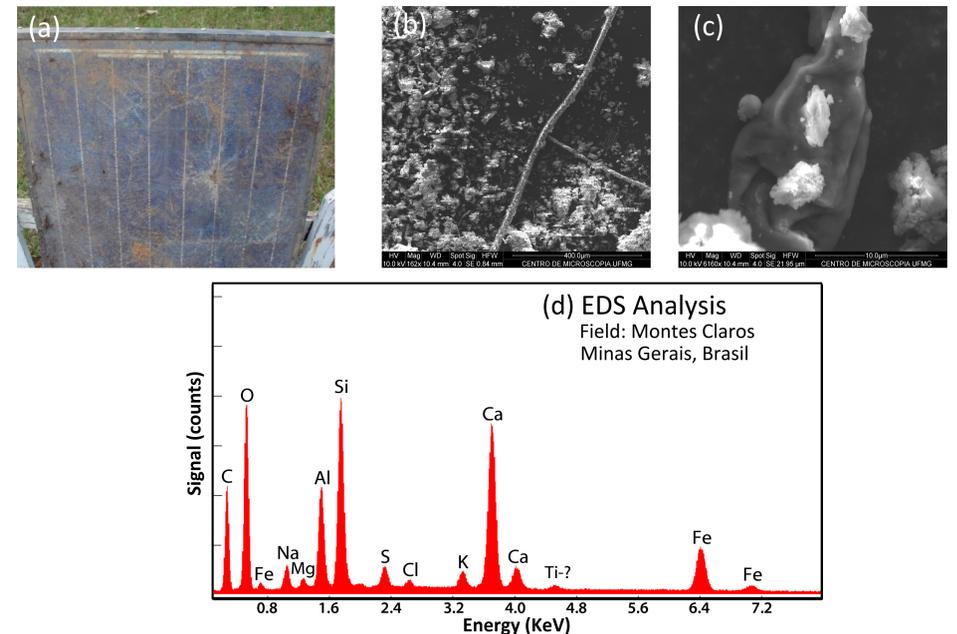


Activities and Objectives

This new, collaborative research program has been commissioned by the government of Brasil (through the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior—CAPES, under “Pesquisador Visitante Especial” and “Ciência sem Fronteiras” programs). The **mission** is to enhance ongoing research in solar-technology reliability, linking worldwide efforts with those important for the now-growing solar investments in the Brasil markets. The **objectives** encompass three interrelated areas important to module *surface* reliability and performance—at the very *first* point of interaction for the incoming solar photons:

- **Soiling Science and Technology** (Creating and validating protocols and procedures, establishing joint test fields in representative climate zones, developing and deploying dust-monitoring stations in key locations, collecting samples and monitoring dust-performance relationships, comprehensive dust/soiling chemical and physical analysis, fundamental adhesive-property characterization [from the nanoscale], and developing a framework for dust testing standards based on Brasil’s specific climatic conditions)
- **Coatings and Films for Performance Enhancement** (Nanotechnology-based antireflection and dust mitigation coatings, including novel dual-purpose designs)
- **Next-Generation Materials Science: Materials by Design** (Design and realization of next-generation (nanoscale) coatings by revolutionary materials science and discovery)

Initial Soiling Investigations: Chemical & Physical Analyses



Figur 2 Preliminary characterization of dust sample from PV module (a) in test field a Montes Claros (Mina Gerais). (b) an (c) are secondary electron images of dus particles, with the light particles (seen i (c)) likely being glass from the broken module surface. (d) ED compositional analysis o dus soiling sample, with the Si-O from the glass. These analyses wer performed to validate the procedures for dus characterization i Brasil. Other characterization includes: AFM, STM, HREM, SAM, SIMS, XPS, PES, XAFS, EDS, ICP-MS, FTIR, and XRD.

Monitoring Station Design

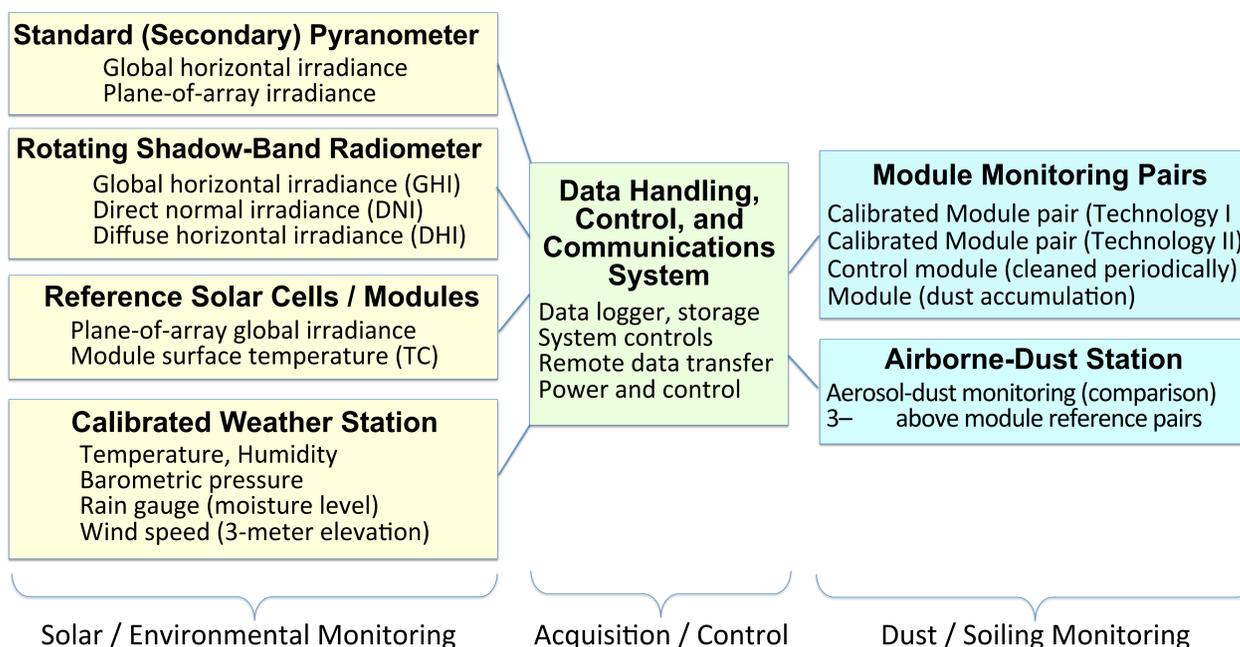


Figure 1. Functional description of components of “Dust / Soiling Monitoring Station,” indicating interactions and equipment / system capabilities.

Brasil Partner and Test Locations

- R&D Lead partner (test site)
- Collaborating partner (Test / monitoring site)
- Pending test / monitoring site

Partner Responsibilities

PUC-Minas and RASEI:

- Research management
- Monitoring stations (design, siting, deployment, data acquisition and interpretation)
- Dust / coatings characterization
- Materials design / evaluation
- Reliability testing / monitoring
- Industry points-of-contact

IME:

- Lead for coatings development and deposition
- Soiling monitoring / testing

ASU:

- Lead for standards
- Soiling monitoring / reliability

UFMG; CNPEM

- Dust, thin-film characterization

PUC-RS; USP; UF-Bahia

- Field testing; dust monitoring



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