IMT SCHOOL FOR ADVANCED STUDIES LUCCA

Presentazione del MUSAM-Lab

Strumenti di caratterizzazione per materiali e superfici mediante integrazione tra virtual testing e sperimentazione

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IMT SCHOOL FOR ADVANCED STUDIES LUCCA

Multi-scale Analysis of Materials
MUSAM Research unit

Laboratorio regionale «**Cantieri 4.0**» e del macronodo del centro di competenza nazionale «**ARTES4.0**» su I4.0

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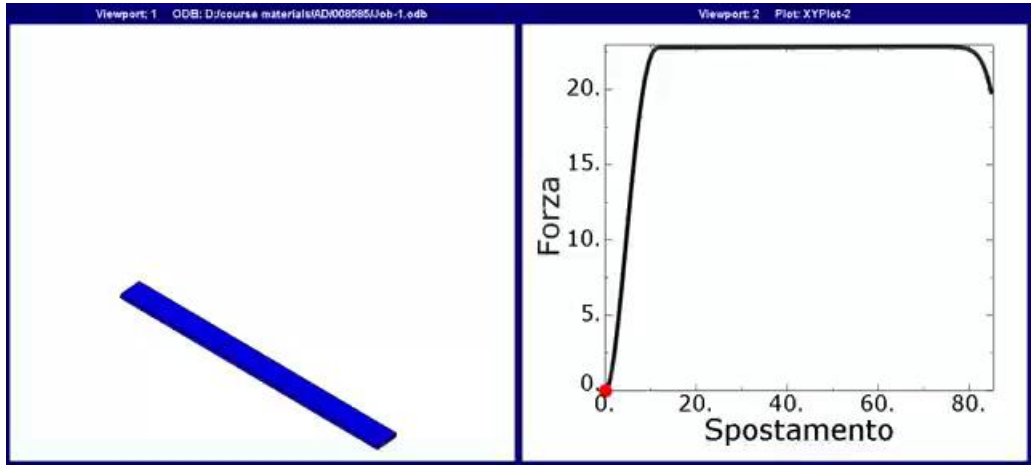
- 3D confocal profilometer (LEICA, DCM 3D)
- Scanning Electron Microscope (ZEISS, EVO MA15)
- Micromechanical testing stage (DEBEN, 5000S)
- Universal testing machine with a thermostatic chamber (Zwick/Roell, Z010TH) & peeling test setup
- Thermocamera (FLIR, T640bx)
- Photocamera for electroluminesce (PCO, 1300 Solar)
- 3D displacement correlation technique (Correlated Solutions, VIC3D)

Recycling of photovoltaic laminates through virtual peeling test

Description: large deformation interface element considering the effect of moisture and temperature.

Sector and market: photovoltaics, electronics, fashion, etc.

Innovation and advantages: From the technical viewpoint, the numerical results show that peeling is energetically preferable over crushing to disassemble and recycle PV laminates at the end of their lifetime. The proposed modeling approach can effectively contribute to virtually design new methods for PV recycling.



Peeling simulation

Publication:

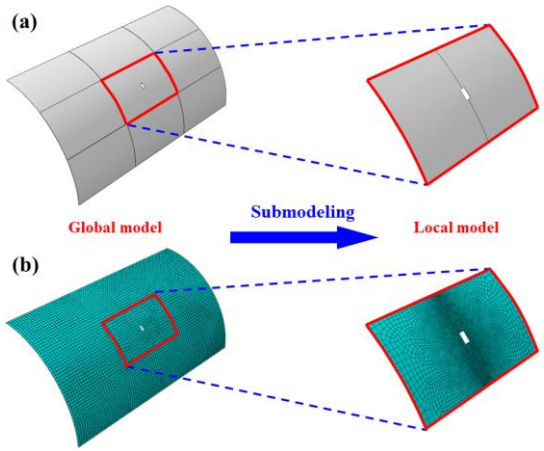
Liu, Z., Reinoso, J. and Paggi, M., 2022. A humidity dose-CZM formulation to simulate new end-of-life recycling methods for photovoltaic laminates. Engineering Fracture Mechanics, 259, p.108125.

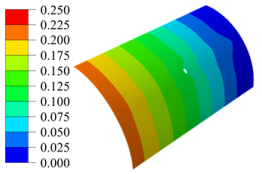
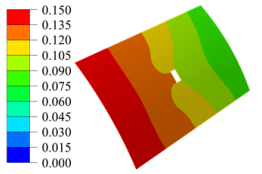
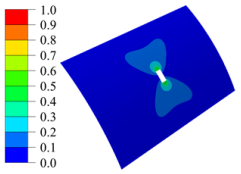
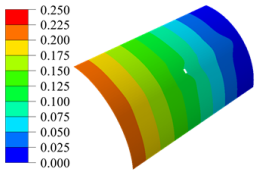
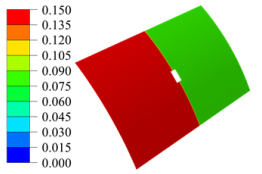
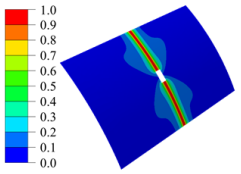
Global-local approach for phase field fracture modeling of large-scale shell structures under both static and fatigue loading

Description: phase field approach with efficient quasi-newton solution scheme, global local approach, fatigue and static loading

Sector and market: photovoltaics, aerospace, electronics, fashion, etc.

Innovation and advantages: to save the computational cost of phase field fracture modeling in large-scale thin-walled structures, a global-local approach is investigated in this work, and its effectiveness is verified by the modeling of a quarter of cylindrical plate subjected to both static and fatigue cyclic loading conditions, which can be appealing to industrial applications.



Type / Time	Displacement of global model	Displacement of local model	Phase field of local model
Time 1			
Time 2			

Hygro-thermo-mechanical modeling of photovoltaic laminates with polymeric interface

Description: hygro-thermo-mechanical coupling, thermo-visco-elastic behavior, moisture diffusion

Sector and market: photovoltaics, aerospace, electronics, fashion, etc.

Innovation and advantages: A three-dimensional hygro-thermo-mechanical computational framework for the photovoltaic (PV) laminates as well as its numerical implementation is established in this work. The proposed method is applied to the simulation of three international standard tests of PV modules, namely the damp heat test, the humidity freeze test, and the thermal cycling test, and numerical predictions are compared with analytical solution for the damp heat case with the constant temperature boundary condition, as well as experimental electroluminescence (EL) images obtained from the thermal cycling test with the cyclic temperature boundary condition, in which good consistency demonstrates the effectiveness and reliability of this modeling framework.