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## An innovative method of treatment of multilayer and multi constituent waste by supercritical CO<sub>2</sub> delamination: an example with photovoltaic panels

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Energy production from photovoltaic panels sharply increases owing to worldwide demand and transition toward decarbonized energy generation. End of life panels mass is expected to reach up to 8 million tons in 2030, which makes necessary a cost-effective and eco-friendly recycling process.

The majority of crystalline silicon based photovoltaic panels has a multilayer structure with a glass plate, a polymer backsheet and the cell encapsulated in an elastomer. To recover silicon based cell, separation step is mandatory; it generally involves mechanical, thermal and/or chemical processes. However, these processes either have high energy consumption or generate high flows of secondary effluents. To overcome these drawbacks, an innovative process based on supercritical CO<sub>2</sub> (SCCO<sub>2</sub>) delamination has been studied.

The principle of SCCO<sub>2</sub> delamination is as follows: the encapsulant polymer absorbs SCCO<sub>2</sub> before fast depressurization inducing foaming and consequently loss of adhesion at the interfaces.

The efficiency of this process has been assessed considering three encapsulants: ethylene-vinyl acetate (EVA), elastomeric polyolefin (POE) and ethylene methacrylic acid ionomer. According to the nature of each encapsulant and well defined methodology [1], operating temperature (between 60 and 90°C) and pressure (between 100 and 140 bar) and time duration have been determined. Results shows that SCCO<sub>2</sub> process allows to consider delamination of first generation EVA-based photovoltaic modules and next generation of modules constituted with ionomers. Works are in progress in order to improve results on POE and evaluate scale-up on real photovoltaic panels at m<sup>2</sup> scale.

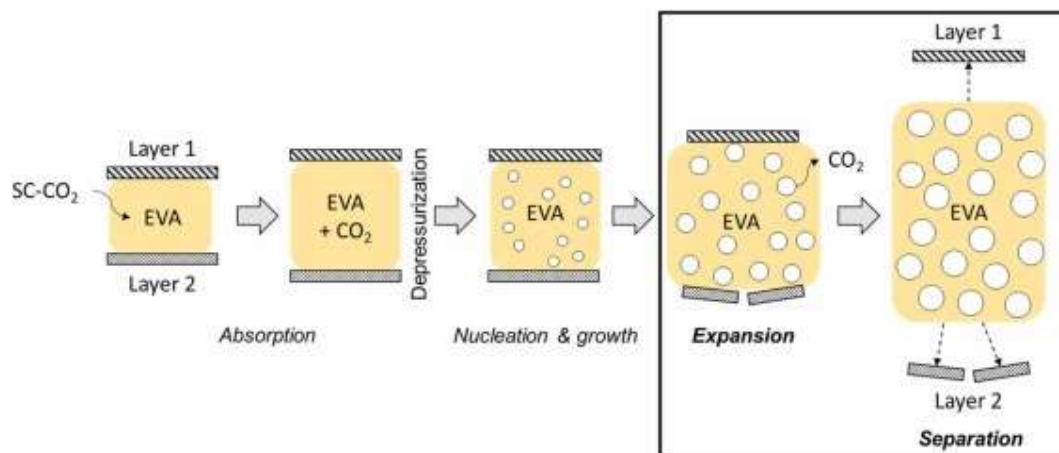


Fig. 1. Description of SCCO<sub>2</sub> delamination mechanism up to loss of adhesion at the interfaces.

### References:

1) A. Briand, A. Leybros, O. Doucet, J.C. Ruiz, P. Fontaine-Giraud, L. Liotaud and A. Grandjean, *Journal of Cleaner Production*, 410, 137292 (2023),

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