

## Motivation/Objective

- Delamination is a failure mechanism commonly observed in interfaces of plastically encapsulated microelectronics. Adhesion strength is used as a quantitative measure of an interface's resistance to delamination.
- The EMC/PSR (epoxy molding compound/photo solder resist) interface was observed to delaminate in MUF packages.

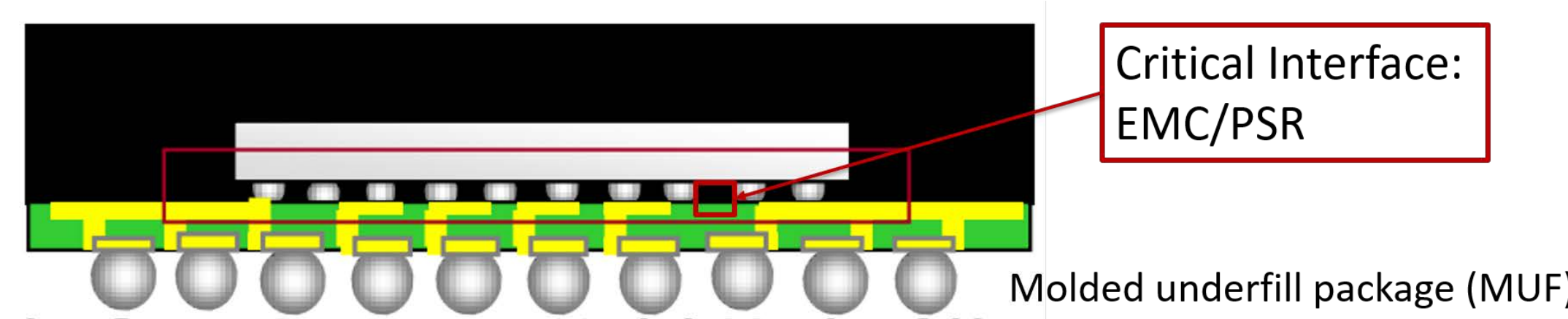


Figure 1. Illustration of the MUF and its EMC/PSR interface

- A testing configuration was developed to quantitatively evaluate the high adhesion of the EMC/PSR interface with quick turnaround for industry.

## Method

- Implemented the Modified Single Cantilever Adhesion Test (MSCAT).
- The proposed method enables quick and quantitative in-situ testing of the interface while maintaining a low mode mixity at the crack tip.
- Specimen is secured to a mechanical test stand and pin loading is applied to the specimen under displacement control.
- A special loading fixture was designed so that the applied load on the loading lip is consistent through the specimen width.

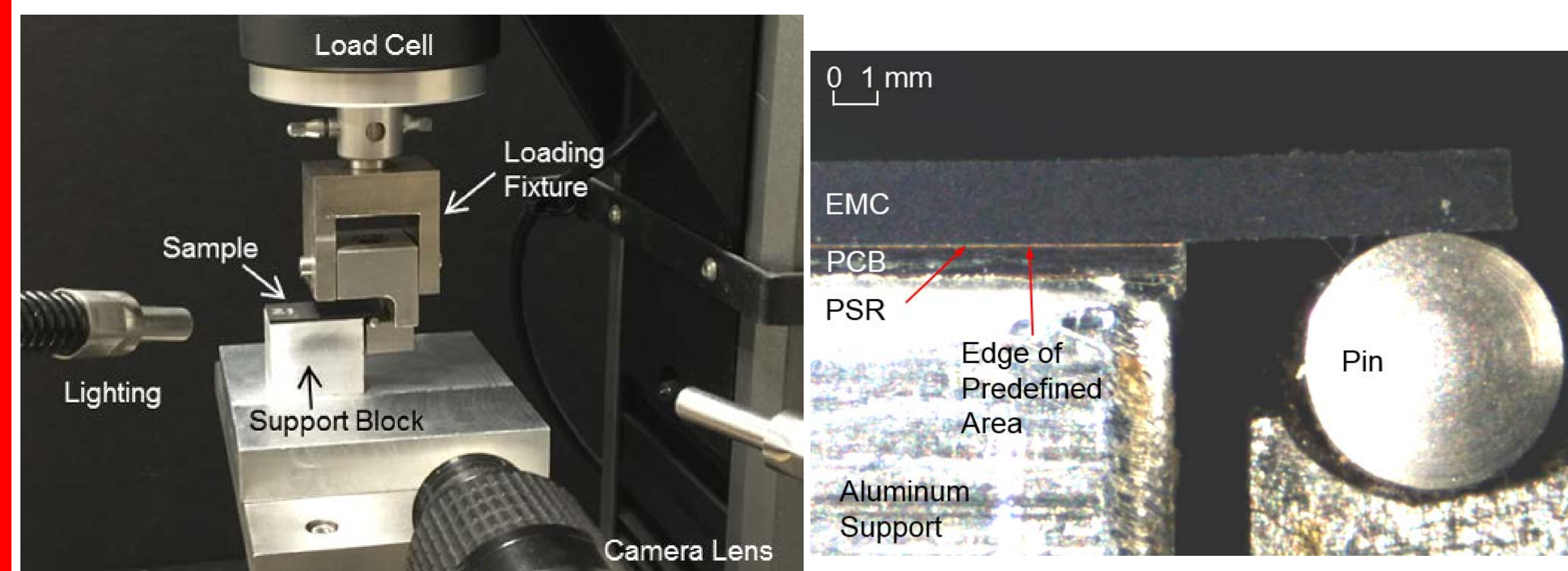


Figure 3. MSCAT setup and implementation

Video of test can be seen here:  
<https://www.youtube.com/watch?v=1GwFDZYzl6w&feature=youtu.be>

## Experiment and Numerical Validation

### Specimen preparation

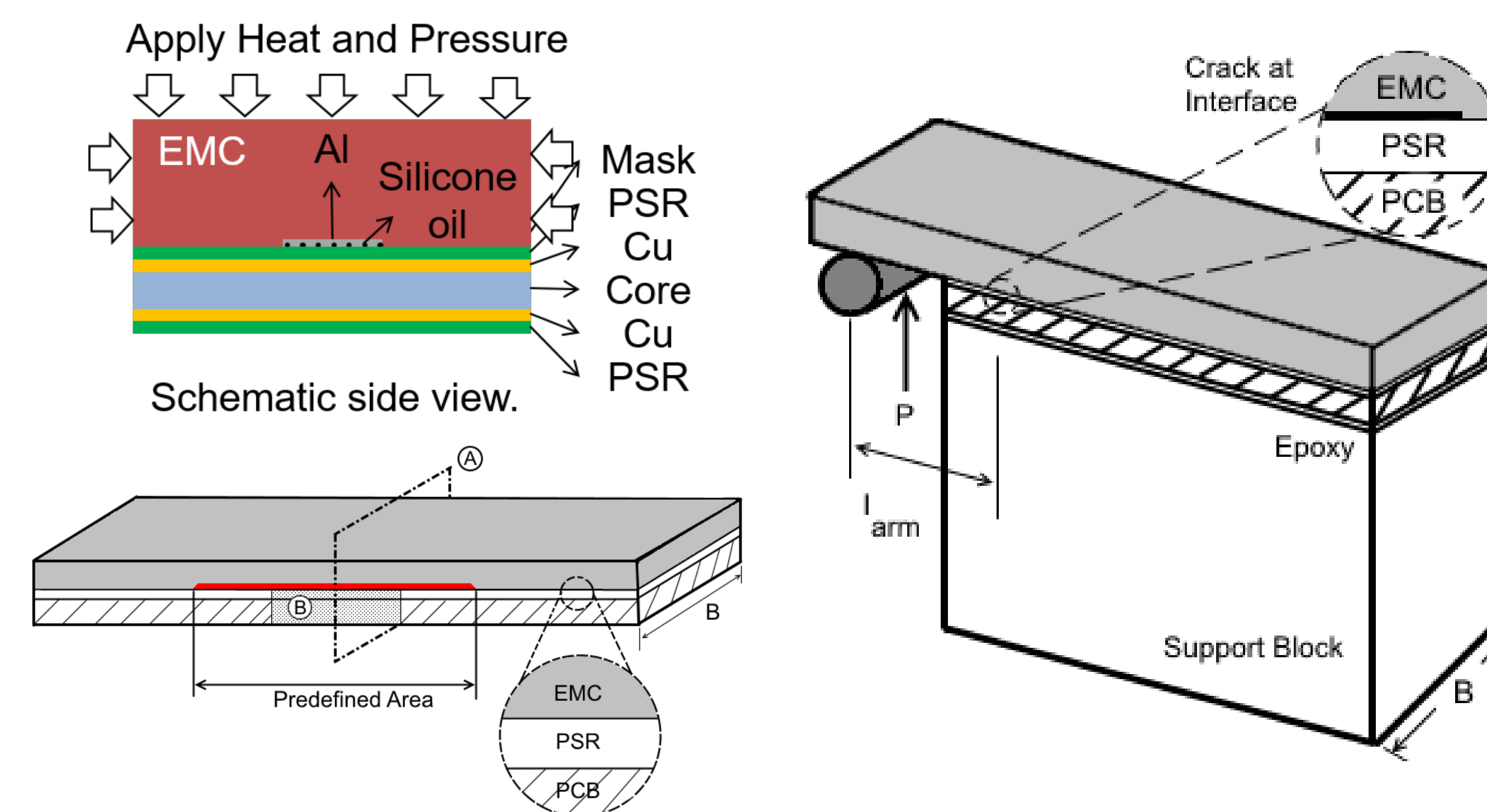


Figure 4. Procedure for preparing EMC/PSR specimens

### Experimental results

- Applied MSCAT to quantitatively compare potential material sets for the EMC/PSR interface.
- Data showed extremely accurate results for adhesion strength testing.

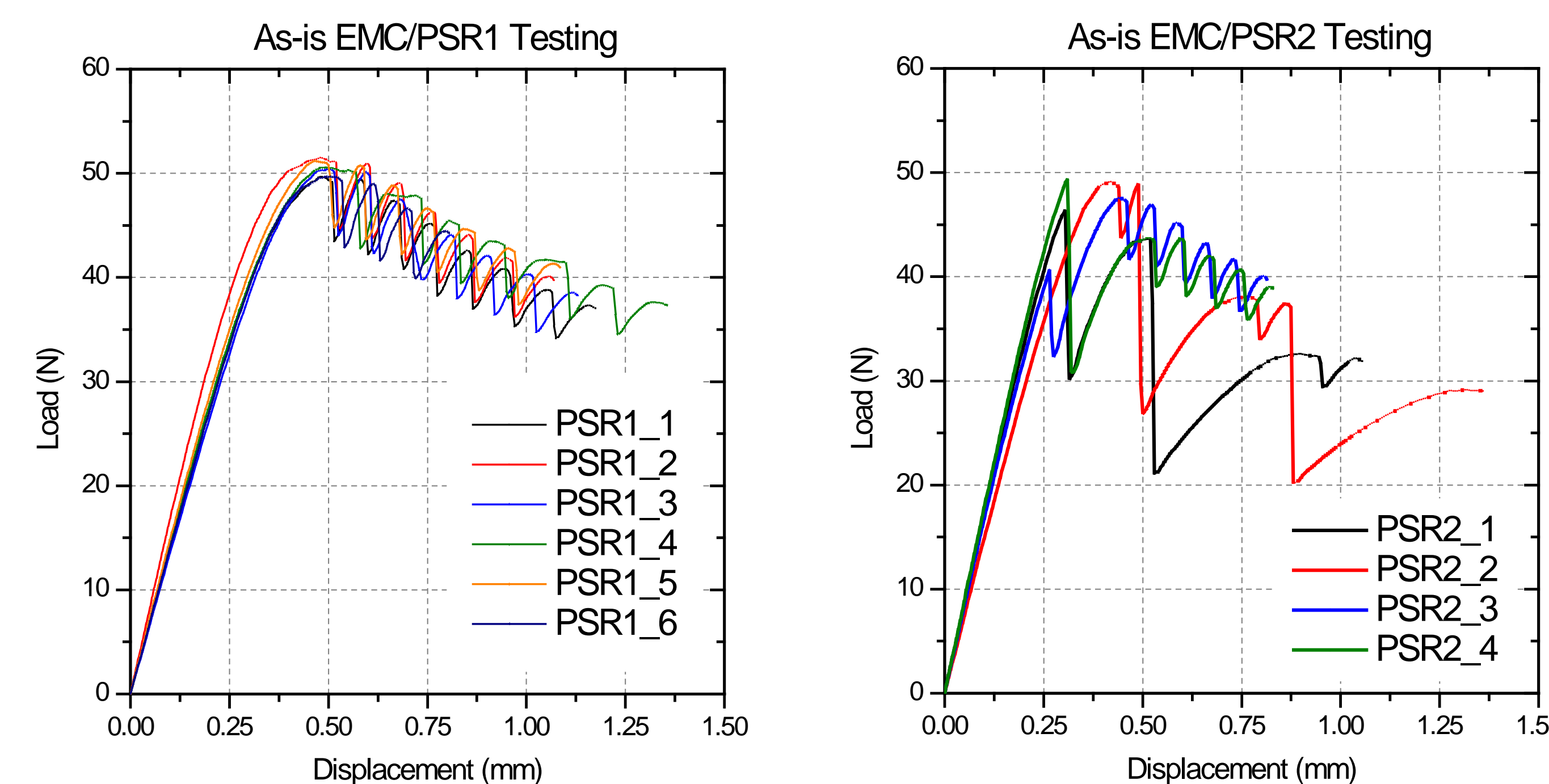


Figure 5. Load vs. displacement plots for EMC/PSR1 and EMC/PSR2

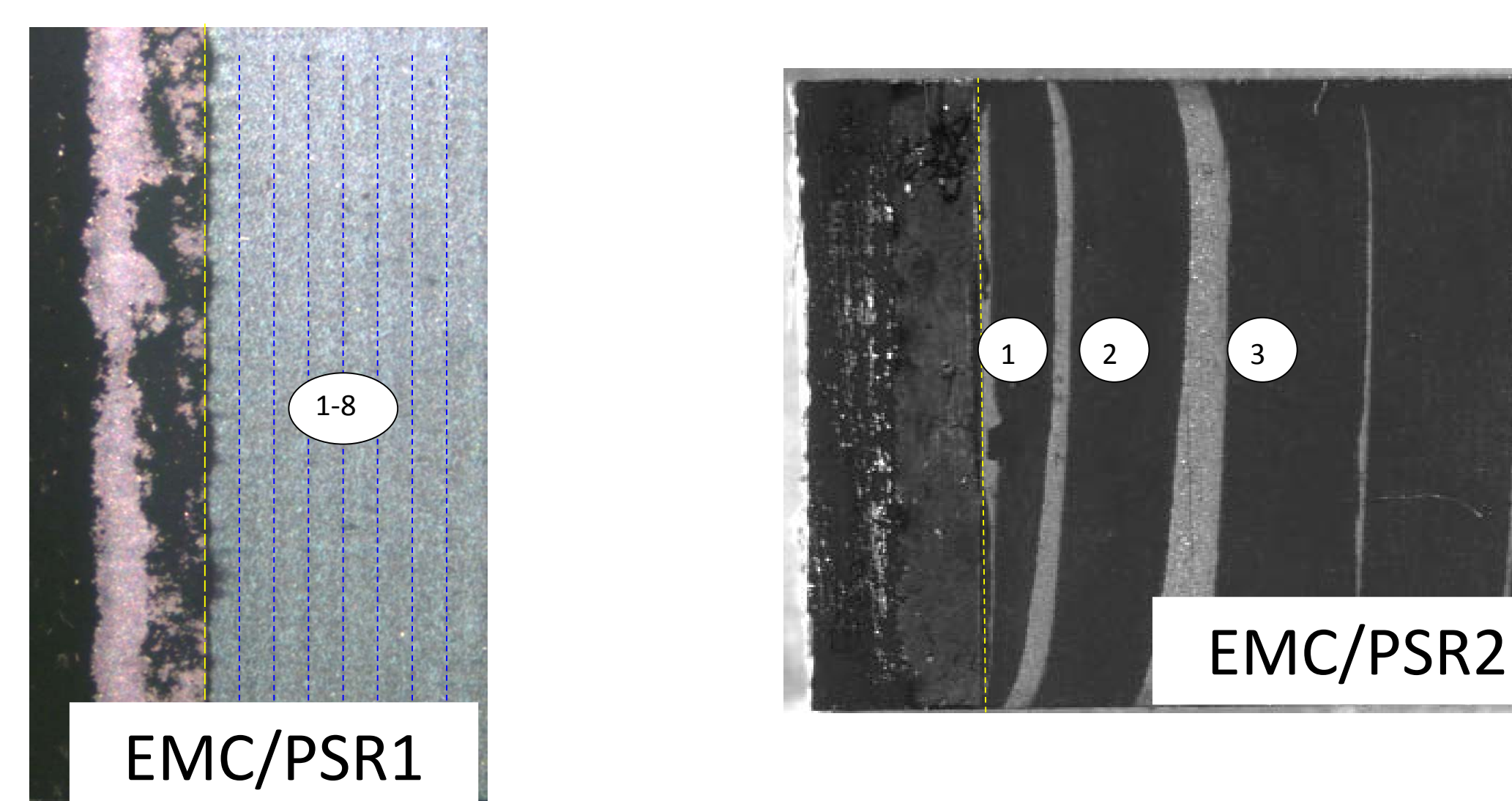


Figure 6. Typical crackfronts for EMC/PSR1 and EMC/PSR2

### Numerical methods

- 2D plane strain model in ANSYS with refined element mesh at crack tip was used for J-integral and Virtual Crack Closure Technique (VCCT) methods to determine adhesion strength.

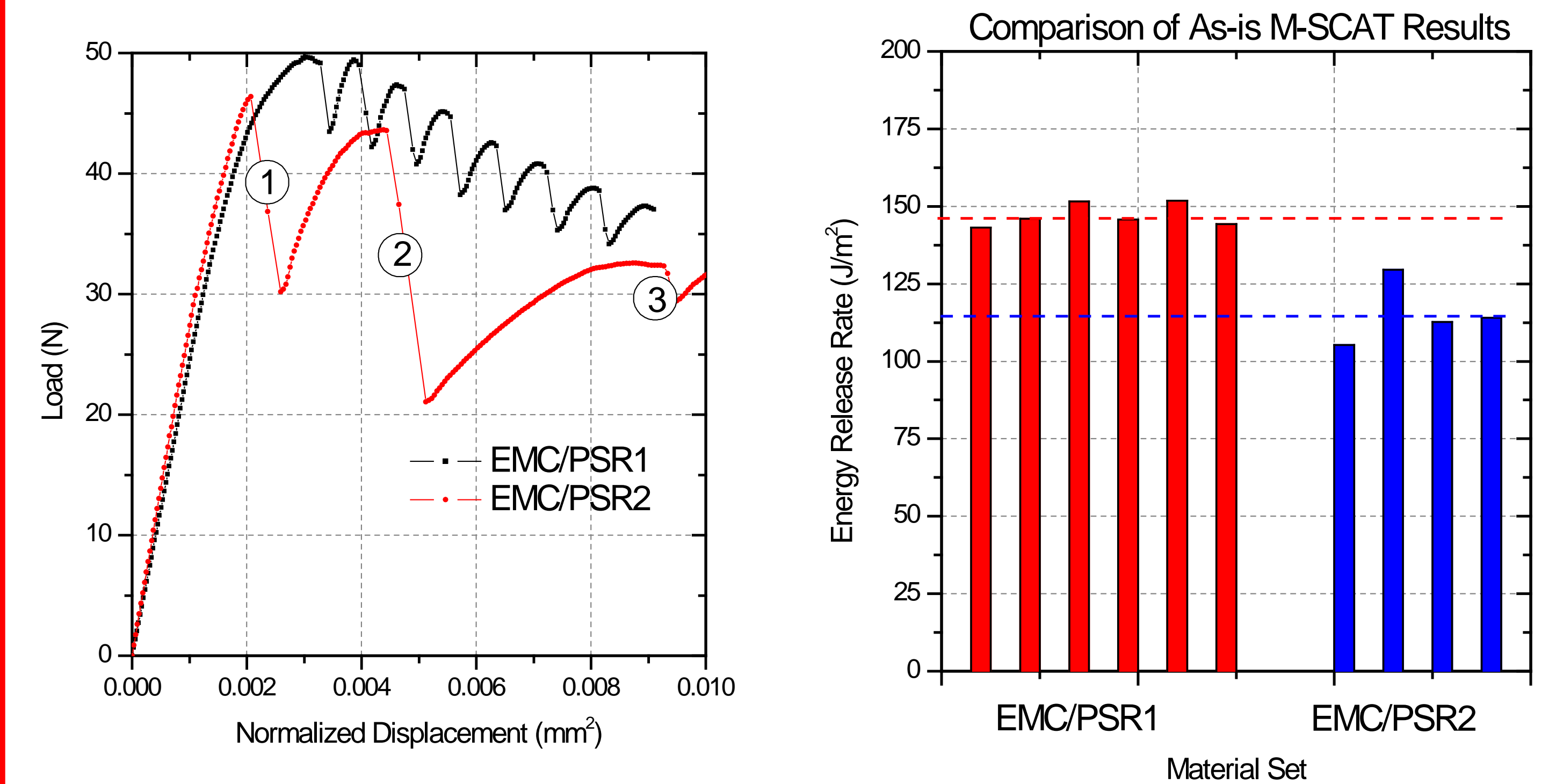


Figure 8. Comparison between two potential material sets

## Impact

- An adhesion testing method called the Modified Single Cantilever Adhesion Test (MSCAT) was developed and proven to be effective at evaluating the large adhesion strengths of the EMC/PSR interface in thin multilayer structures in a quick and quantitative manner.
- It was used to quantitatively compare the adhesion strengths of potential material sets for the EMC/PSR interface in MUF packages. The procedure and implementation of MSCAT are shown in reference.
- This configuration enables reduction of development time through its quick and quantitative analysis of an interface's adhesion strength.

## Acknowledgements

- Sponsored by CALCE in collaboration with Samsung Electronics and Samsung Electro-Mechanics Co.

## Related Publication

- K. Mahan, et al., "Modified single cantilever adhesion test for EMC/PSR interface in thin semiconductor packages." *Microelectronics Reliability*, 63 (2016): 134-141.