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# Characterization and debonding of adhesive tapes for prismatic cell-to-cell bonding

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## 1. Introduction

As electric vehicles (EVs) drive the transition toward sustainable transportation, addressing the end-of-life (EoL) challenges of lithium-ion battery packs is essential. Current battery designs often rely on permanent adhesive joints, hindering efficient disassembly and recycling [1]. This study explores the role of stretch and release pressure sensitive adhesives (PSA) in prismatic cell-to-cell dismantling, aiming to achieve it with low energy input and non-destructively. Figure 1 illustrates the application of PSAs between cells, alongside two additional adhesive types that are among the most commonly used across the EV battery pack manufacturing.

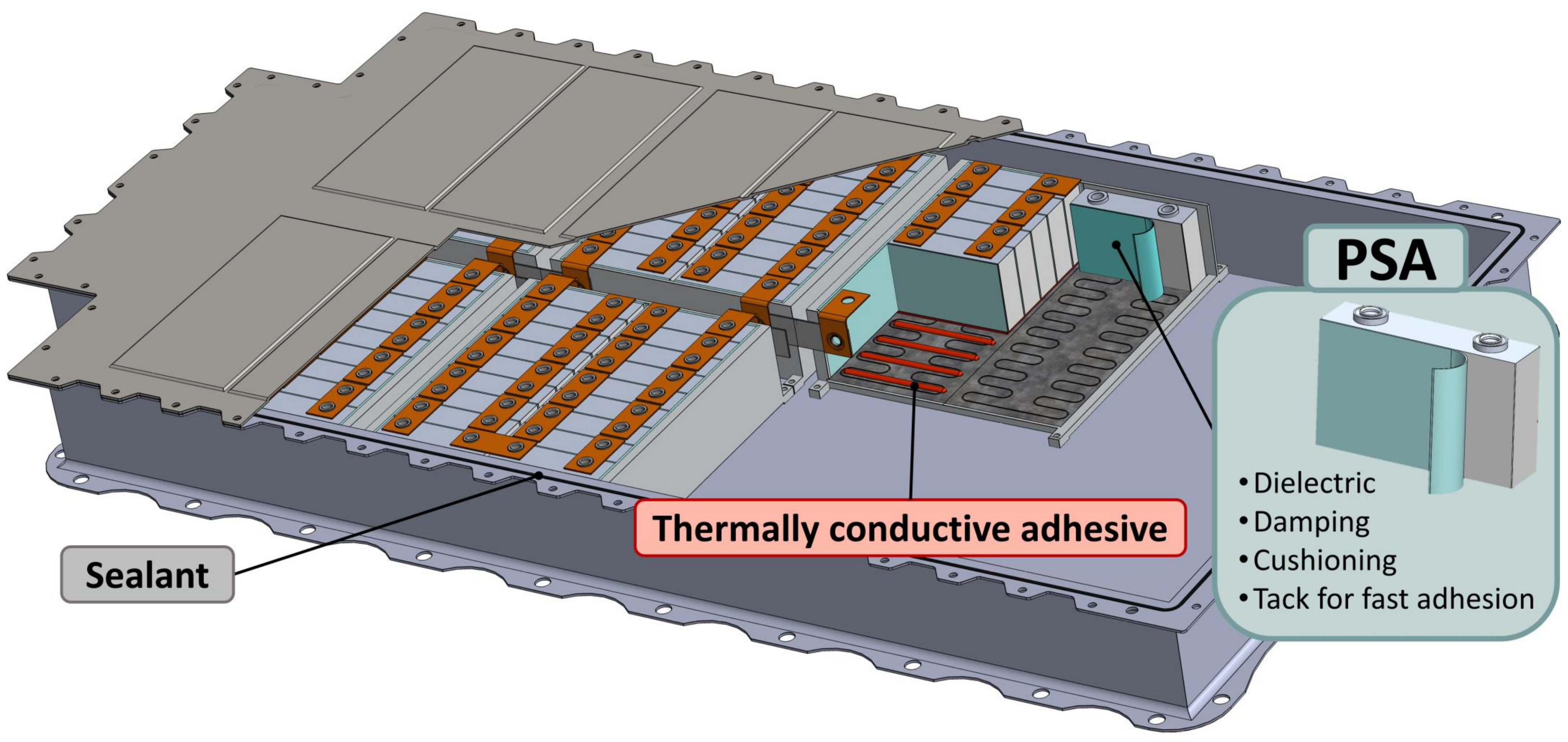



Figure 1. PSA key properties in an EV battery pack concept

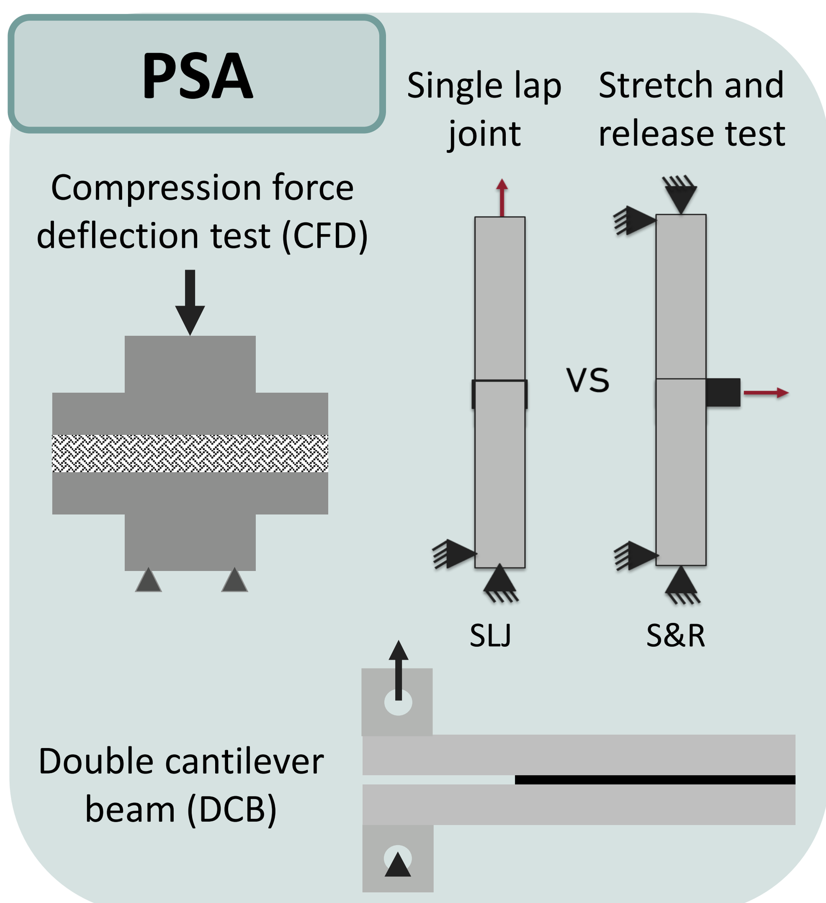
## 2. Materials

**PSA**

| Already in use | VS | Trial S&R |
|---|---|---|
| • *3M* 300LSE | | • *tesa* 76565 |
| • PSA Pad from *Gotion* | | • *tesa* 64911 |

## 3. Testing campaign

| Testing conditions | | |
|---|---|---|
| **Test** | **Rate (mm/min)** | **Specifications** |
| CFD | 0.2 | ø62mm, 1 adhesive layer |
| SLJ | 1 | Al substrates, 12.5mm of overlap (ASTM D1002) |
| S&R | 200 | Al substrate, 12.5, 25 and 50mm of overlap |
| DCB | 1 | PMMA substrates, J-integral method for the data reduction scheme |




## 4. Validation

The debondable tesa adhesives show superior lap shear strength (LSS) compared to the benchmarked tapes. In CFD tests, tesa 64911 enables greater cell expansion, outperforming the Gotion PSA pad, while tesa 76565 offers higher stiffness but with limited expansion (Figure 3) [2]. Upon debonding, the load required to stretch and release is estimated to be up to 10 times lower than the LSS, allowing for ease disassembly (Figure 4). DCB tests allowed to capture the cohesive law in mode I using the direct method [3]. Since the cell separation is similar to a DCB, a CZM numerical model was developed to predict the peak load of real cells with different bonded geometries.

| PSA | LSS [kPa] |
|---|---|
| 3M 300 | 448 ± 23 |
| Gotion | 375 ± 31 |

VS

| PSA | LSS [kPa] |
|---|---|
| tesa 76565 | 477 ± 31 |
| tesa 64911 | 484 ± 21 |

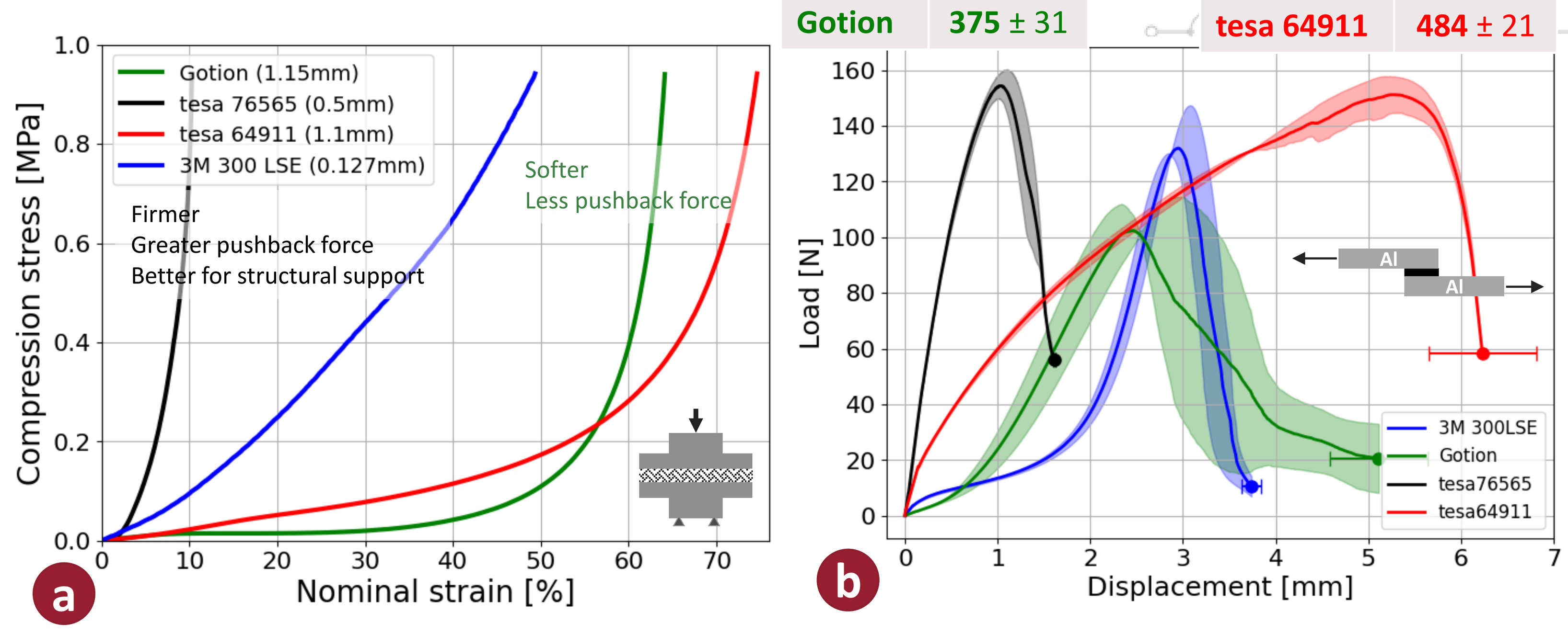



Figure 3. a) CFD test; b) Single lap joint test (12.5 mm overlap) and LSS

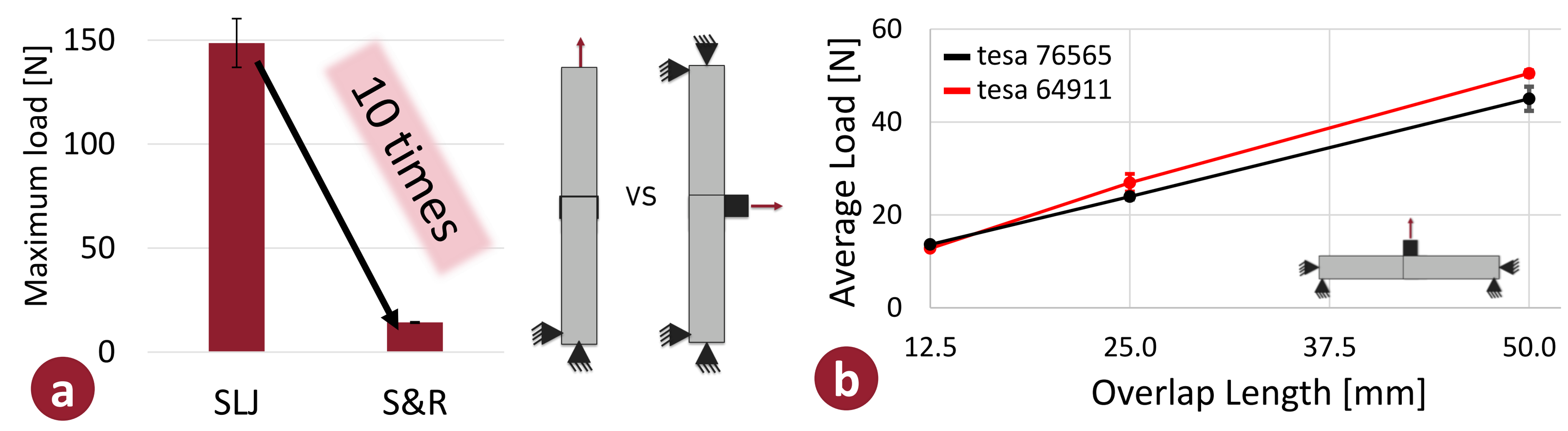



Figure 4. a) S&R vs SLJ peak load; b) required S&R load envelope

Figure 5 shows the numerical result for one S&R tape, being reproduceable for all the PSAs tested.

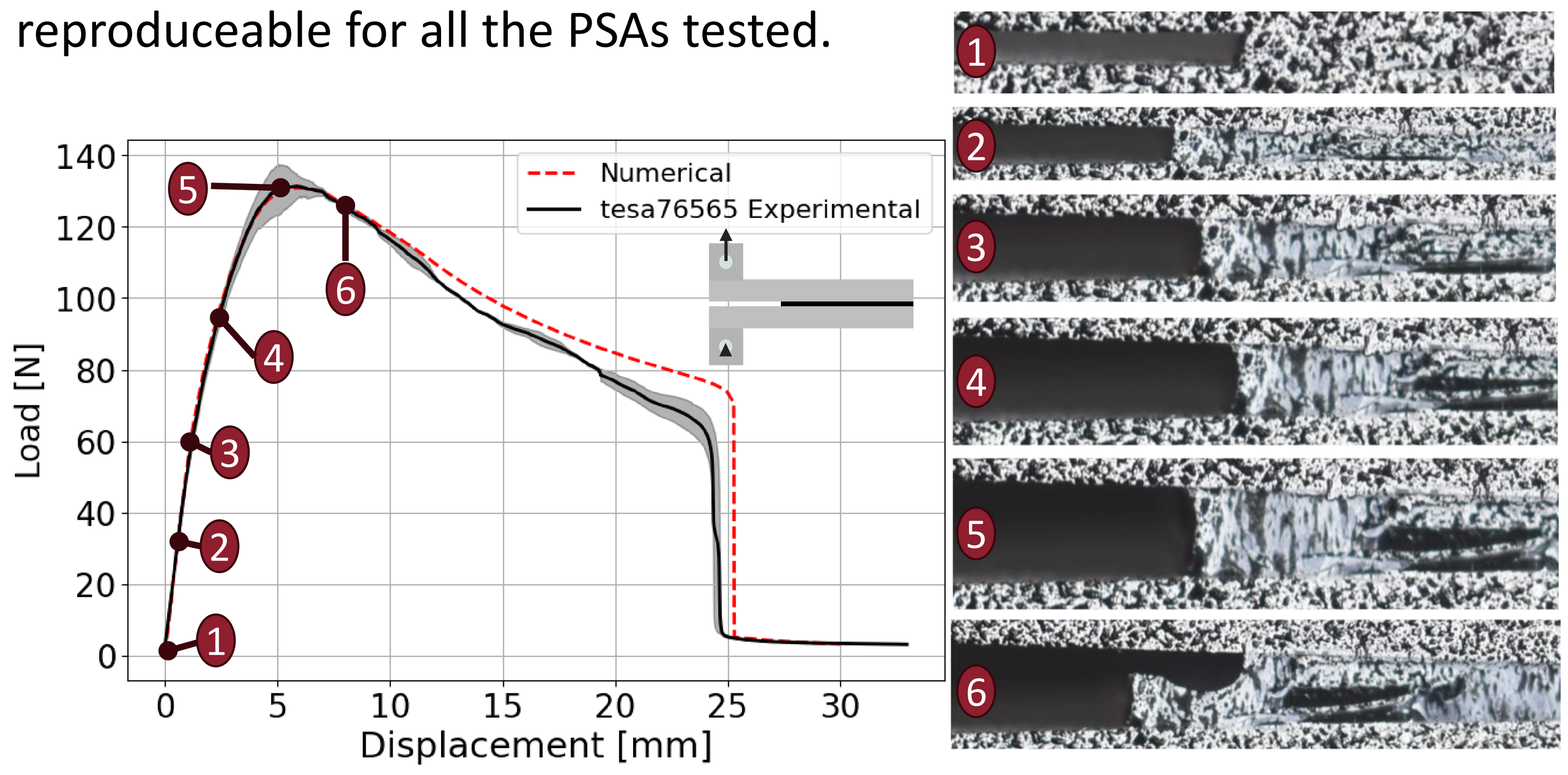
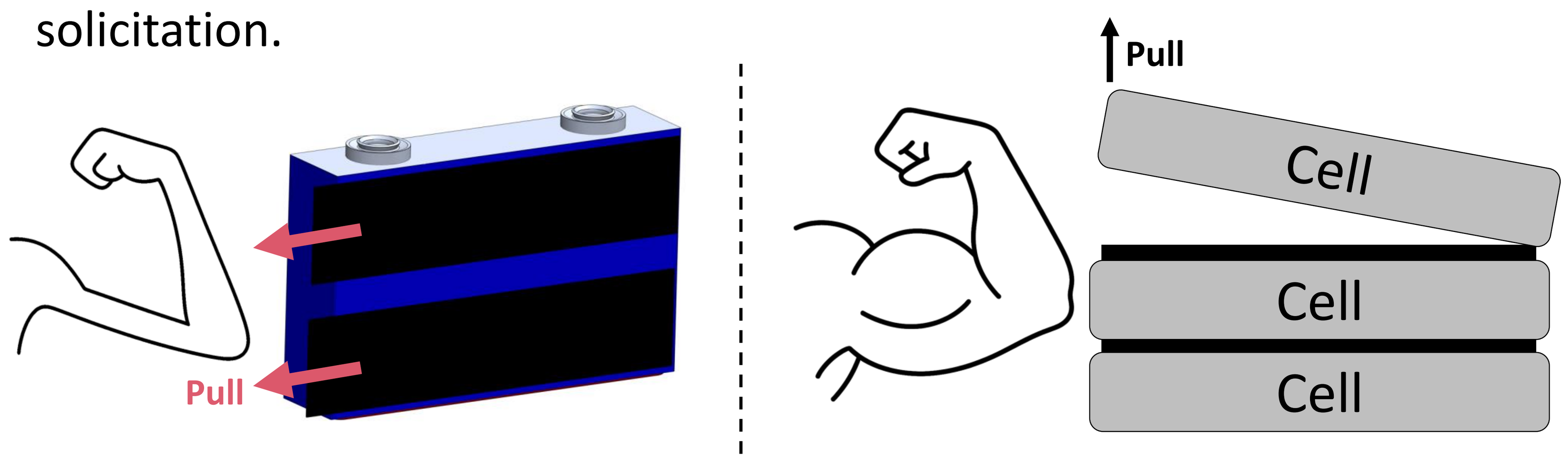



Figure 5. Numerical *vs* experimental load-displacement curve and crack tip opening displacement (CTOD) measurement for the tesa 76565 DCB specimens

## 5. Conclusions

Stretch & release tapes performed equal to or better than commercial PSAs regarding the performed mechanical tests, with the added benefit of significantly lower debonding forces, unlike commercial PSAs which require excessive force for cell to separation upon mode I solicitation.




## References

[1] Rodrigues, Vasco CMB, et al. "Adhesive bonding in automotive battery pack manufacturing and dismantling: a review." Discover Mechanical Engineering 4.1 (2025): 1-36

[2] Mei, Wenxin, et al. "An investigation on expansion behavior of lithium ion battery based on the thermal-mechanical coupling model." Journal of cleaner production 274 (2020): 122643

[3] Biel, Anders, and Ulf Stigh. "Cohesive zone modelling of nucleation, growth and coalesce of cavities." International Journal of Fracture 204.2 (2017): 159-174.00

## Acknoledgments

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