

ATDI

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Óbuda
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Semester Report - September 2021/2022

**Modeling lead-free interconnect reliability
under creep in advanced packaging.**

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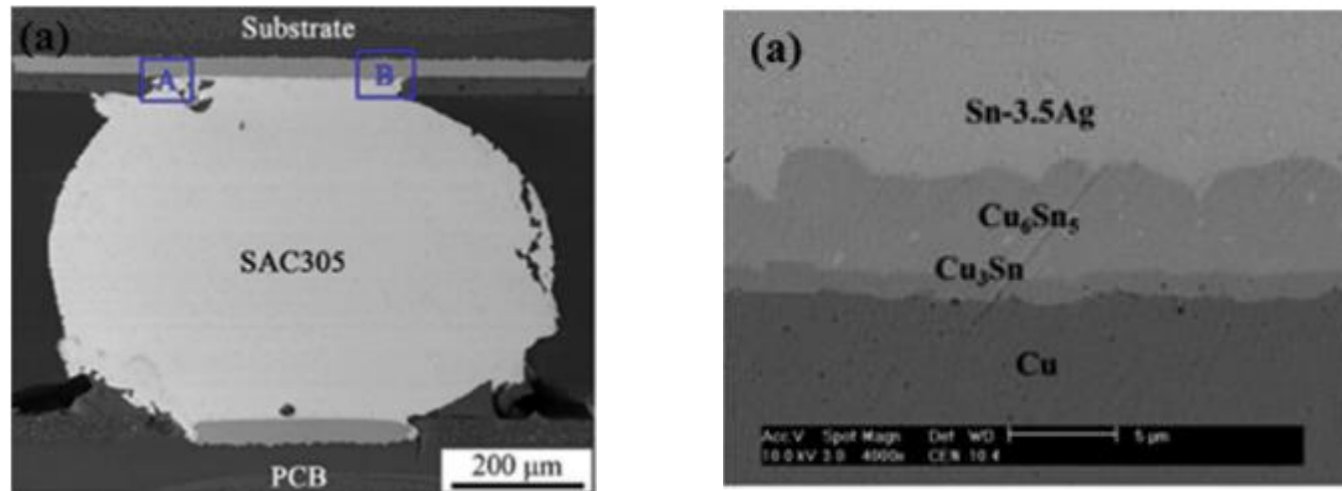
- ▶ Intermetallic Compound (IMC)
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IMC intermetallic Compound



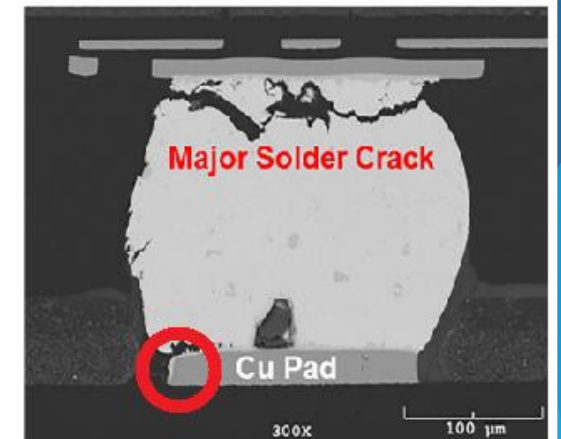
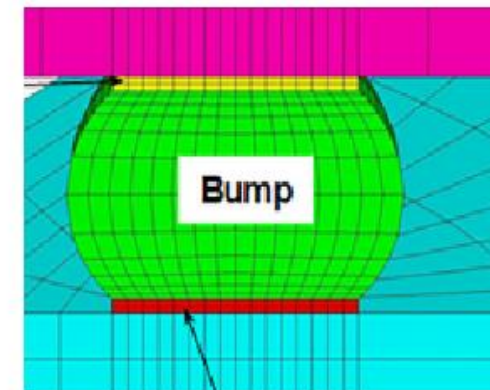
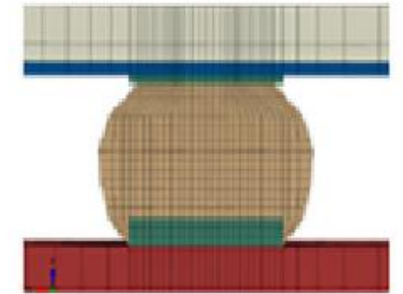
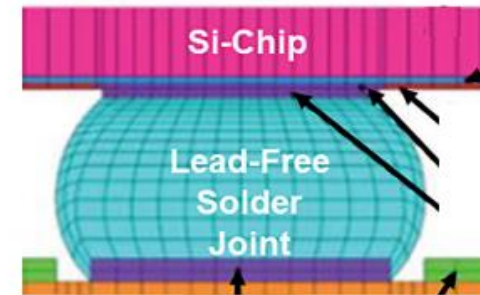
Scanning Electron Microscopic (SEM) images of IMC morphology of solder joint interface [1].

- Cu_6Sn_5 (η -phase) and Cu_3Sn (ϵ -phase)

The hard and brittle properties of IMCs cause significant stress concentrations along the interfaces between the solder and contiguous materials, forming potential locations for crack initiation [2].

Cu pad edge geometry

- Sharp Edge [3].
- Vicinity of the crack initiation.
- Easy to design.
- Optimization of computer sources.

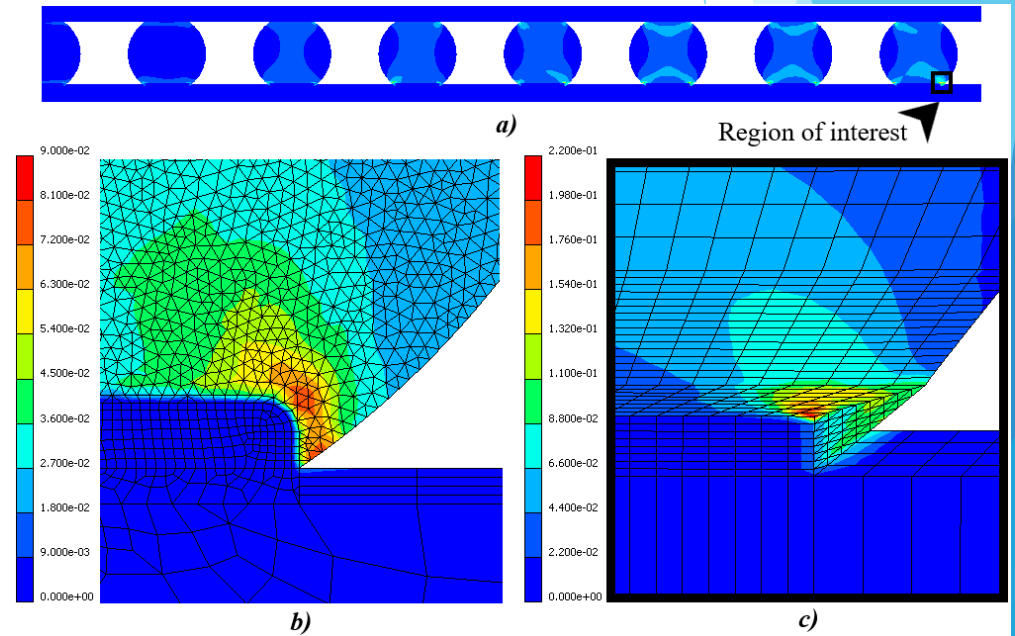


Results - previous semesters

Creep and Reliability Prediction of a Fan-Out WLP Influenced by the Visco-Plastic Properties of the Solder – **2nd STAGE REVIEW**

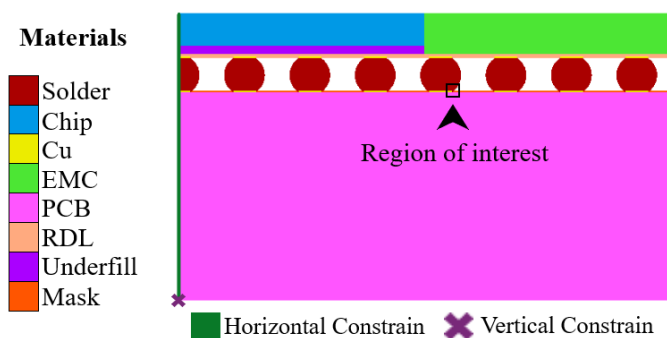
Most relevant conclusion

A change in the copper pad profile shape (squared to rounded) shows a stress reduction and, therefore, more stable creep curves. Additionally, it accentuates the difference of creep values between materials by nearly 16% regarding creep strain values.

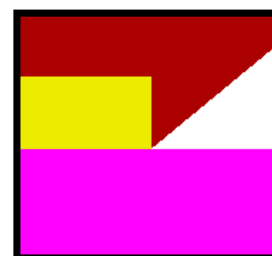


Results - current semester (1/2)

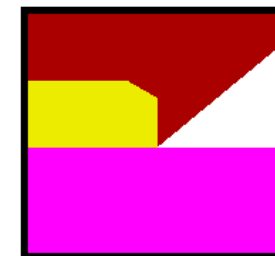
Creep and Reliability Prediction of a Fan-Out WLP Influenced by IMC and Cu pad geometry.



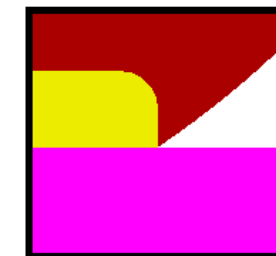
The modelled section details Materials description and boundary conditions,



Sharp

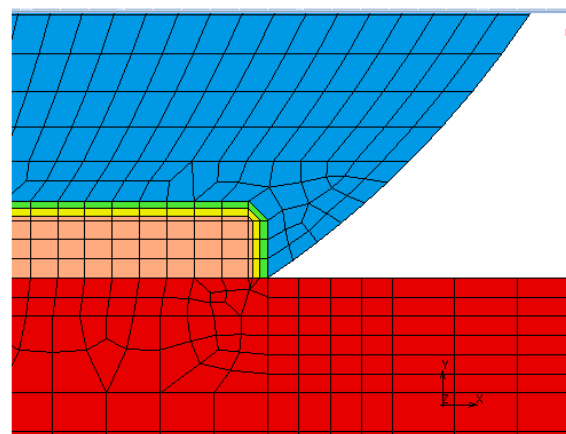


Chamfer

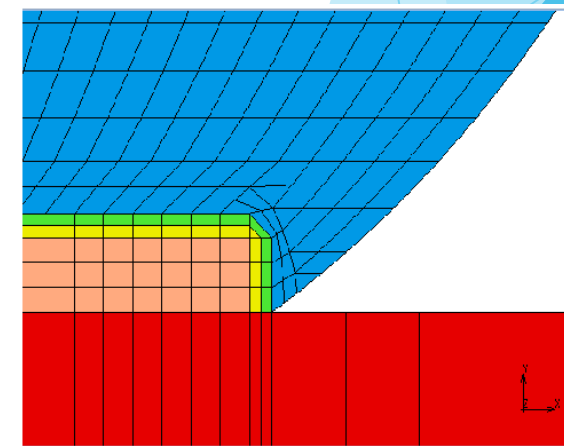


Fillet

Previous Mesh



Current Mesh



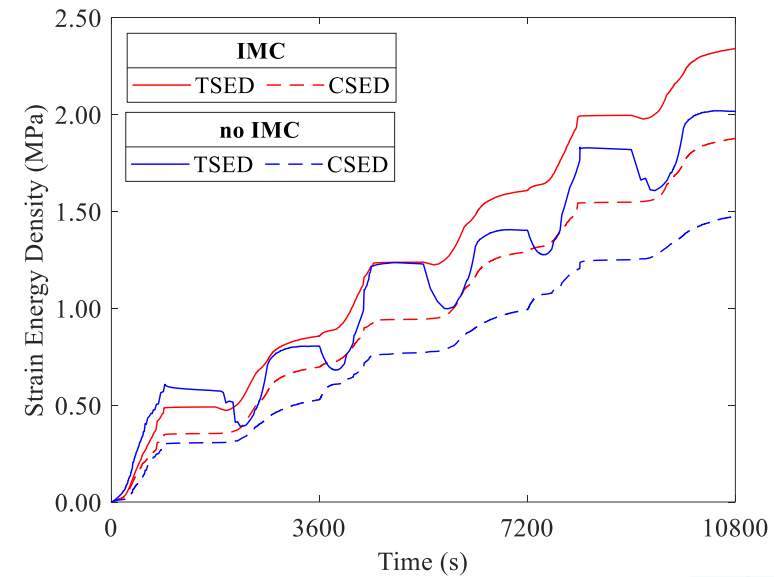
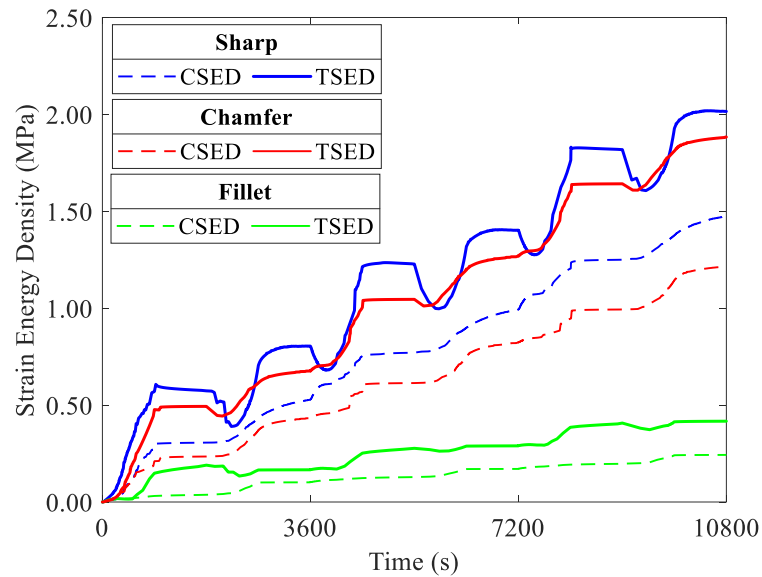
Important factors to be considered.

Mesh density.

Elements arrangement.

Results - current semester (2/2)

Effect of the bond pad geometry and IMC inclusion



Creep Strain Energy Density (CSED) and Total Strain Energy Density (TSED)

Variables: IMC (2) – CU geometry (3) – Solder Material (2)

Early Claims and Conclusions

1. SAC-X solder perform with better endurance to harsh thermomechanical loads.
2. Combination - Viscoplastic behavior (Anand Model) and reliability Model (Morrow Model).
3. Copper pad edge geometry and IMC inclusion in the simulation play an essential role in the Finite Element Method (FEM). Since the critical vicinity of analysis is near the copper pad edge, its shape substantially affects the results.

References

- [1] N. Jiang et al., “Reliability issues of lead-free solder joints in electronic devices,” *Sci. Technol. Adv. Mater.*, vol. 20, no. 1, pp. 876-901, Dec. 2019, doi: 10.1080/14686996.2019.1640072.
- [2] Y. C. Chiou, Y. M. Jen, and S. H. Huang, “Finite element based fatigue life estimation of the solder joints with effect of intermetallic compound growth,” *Microelectron. Reliab.*, vol. 51, no. 12, pp. 2319-2329, 2011, doi: 10.1016/j.microrel.2011.06.025.
- [3] J. H. Lau, “State of the Art of Lead-Free Solder Joint Reliability,” *J. Electron. Packag.*, vol. 143, no. 2, Jun. 2021, doi: 10.1115/1.4048037

Thanks for your kind attention

Questions?