A Molecular Dynamics Study of the Interface Temperature in Ultrasonic Metal Welding

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ABSTRACT

In this study, molecular dynamics simulation of the mechanical and thermal behavior of the mating interface during ultrasonic metal welding is presented. The reciprocating motion of the sonotrode together with the application of the external pressure on the mating parts in the process of ultrasonic welding are the sources of friction heat generation and plastic deformations. Ultrasonic metal welding is a solid state consolidation process, during which the growing interface temperature is far below the melting point of the participating metals.

The rapid process of ultrasonic welding, which takes a few seconds at the longest, involves coupled mechanical and thermal processes, including plastic deformations of the mating parts and a high temperature gradient of the interface. Therefore, molecular dynamics (MD) simulation has been employed to depict the nano-mechanics of this complicated coupled process within the picosecond timescale. To this end, the atomic scale simulation of the microstructure at and in the vicinity of the mating interface has been carried out.

This contribution addresses the interactive effects of the process parameters on the interface temperature distribution, evolution of the interfacial plastic deformations and the diffusion behavior of the interface atoms at the atomic scale. The results of the presented MD simulations are compared to the results from macroscopic scale researches [1].

REFERENCES

[1] Mostafavi, S. , Hesser, D.F. and Markert, B. Effect of process parameters on the interface temperature in ultrasonic aluminum wire bonding. *Int. J. Manuf. Process.* (2018) **36**:104–114.