

Development of a Simplistic Method for Processing Intermetallic Sheet Materials Using Cold Roll Bonding and Reaction Annealing,

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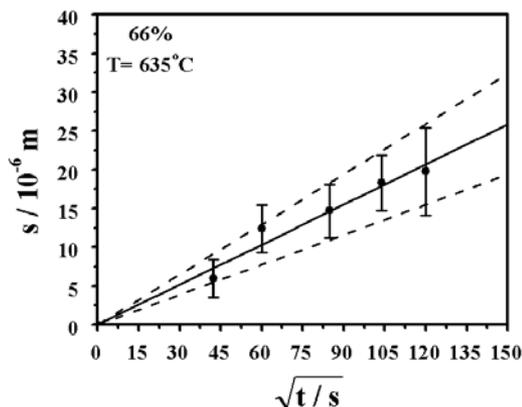
DMR-0206826

Objectives:

- Simplification of the processing of intermetallic sheets from elemental foils
- Investigation of the kinetics for the formation of intermetallics

Kinetics of TiAl_3 :

The kinetics of TiAl_3 was studied by heating the roll bonded Ti/Al multi-laminates to 600-635°C for various times (t) and measuring the size (s) of the reaction layers. $Q = 173 \text{ kJ/mol}$



Process Simplification:

Large Ti-Al intermetallic sheets have been produced using this process (Figure 1). Severe plastic deformation was induced by cold rolling to facilitate the formation of intermetallics during annealing. As a result, ultrafine grained structures were produced (Figure 2). An analytical model was developed which is the first to address the rolling of multiple sheets. Previous models only addressed the rolling of three sheets which is the case for cladding. The model will: (1) suggest optimum rolling conditions (e.g. roll diameter, starting thickness) for bonding of multiple layers and (2) predict the elemental fractions after roll bonding.



Figure 1

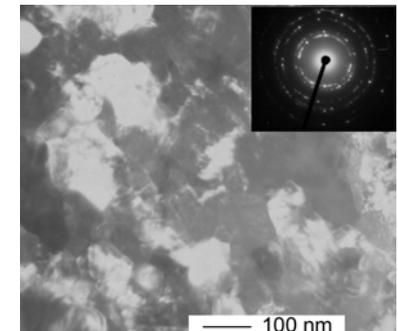


Figure 2. TEM BF image and corresponding SAD pattern

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Broader Impact:

- This work was presented at the Third International Symposium on Ultrafine Grained Materials. Two manuscripts were published in the refereed conference proceedings.
- An invited talk was given at the International Conference on Processing & Manufacturing of Advanced Materials held in Madrid, Spain.
- An expert in engineering mechanics requested that the recently developed analytical model be submitted for publication in the *Journal of Applied Mechanics*.

Education:

- Two graduate students, one undergraduate student, and one Post-Doc are involved with this project.
- Prentice Singleton, a senior undergraduate student at The University of Alabama, is working on this project for his senior thesis. He performs fusion welding on the as-rolled multi-laminated sheets that are developed by the grad students. Results have shown that the dominant intermetallic compound that forms in the heat-affected zone is TiAl_2 , not TiAl_3 , which dominates during controlled annealing.