Combined Functionalities in Layer-Engineered Actuators with Shape Memory Alloys

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Abstract:

Shape memory alloys have a significant potential to be used in microactuating applications due to a large range of properties that cand be additionally tunned in bi and multimoph structures. While the shape memory alloys properties can be thermally and/or magnetically controlled, the thermoelastic stress that can build up as result of the mismatch between the thermal and elastic properties in bi and multimorph structures can be further used to control the actuation. In fact, since the cantilever-type microactuators processed by shape memory alloy deposition as thin film on a substrate require high temperature processing so that the resulting microstructure is crystalline, it follows that the resulting actuation is influenced by the mismatch between the thermal and elastic properties of the shape memory alloy film and of the substrate.

By appropriately selecting the composition and architecture of the shape memory alloy layers and the substrate it is possible to modify the microactuation in the temperature range of the martensitic phase transformation in the film. Models are designed based on the analyisis of the tehrmoelastic stress that are builtup in bimorph and trimorph architectures that include one or more shape memory alloy films with thermal control of the phase transformation on a substrate that does not undergo a phase transformation in the thermal actuation range. It is concluded that the profile of cantilever-type microactuation cand be controlled through the properties of the film and the substrate.

Keywords:

Thin film actuators, Shape memory, Martensitic transformation, Layered structures.