We present our results concerning the rigidity of a shape memory alloy undergoing cubic-to-tetragonal transformations. Starting from a geometrically linear elastic energy augmented by an interface penalization we derive a non-convex differential inclusion in the energy regime of branching microstructures. Without assuming additional regularity we classify all possible solutions and describe the qualitative rigidity properties of such microstructures. Furthermore, we give insight into quantitative aspects, such as the possibly fractal dimension of the set of macroscopic interfaces, by analyzing the H-measures generated by the microstructures.