Exploiting structural and compositional instabilities in titanium alloys to optimize properties of components fabricated by additive manufacuring

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This paper begins by reviewing various structural and compositional instabilities in titanium alloys, largely identified by application of analytical aberration-corrected (S)TEM, and their roles in various phase transformations which influence significantly microstructures in processed and heat-treated samples. The specific example of additive manufacturing (AM) of titanium alloys is then addressed. The problem to be solved involves the need to effect an equaixed microstructure in printed parts, rather than the coarse columnar microstructure that is usually observed. This is done here by the use of dilute alloying, added to increase the probability of solutal undercooling during the rapid solidification experienced in AM. Because these solute additons are above the solubulity limit in these alloys, heat-treatment studies were conducted to define the heat-treatment possibilities that avoid formation of intermetallic compounds. The results of these heat-treatment studies willl be described, and the means of optimizing microstructure in these alloys will be discussed.