Grain boundary design is a promising method to control grain growth and, thus, material performance at high temperatures. Grain boundaries have low energy states, called complexions, that are dependent on composition, temperature, pressure and grain boundary misorientation. Like bulk phases, grain boundary complexions can undergo first-order transitions that cause discontinuous changes in properties. I will demonstrate how to induce or prevent grain boundary complexion transitions to create tailored microstructures in Eu-doped MgAl$_2$O$_4$. Additionally, we will consider how grain boundary complexion transitions can cause anti-thermal grain growth in SrTiO$_3$, where slower grain growth is observed at higher temperatures. The mechanistic description of how a complexion transition facilitates this anomalous grain growth is necessary to develop anti-thermal structural materials for aerospace applications. However, there are many outstanding questions regarding the kinetic mechanisms of complexion transitions, which limits our ability to implement interface design in a wide range of materials. Potential techniques and methods to solve these issues will be discussed.