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TECHNIQUES FOR REDUCING THE TRANSITION TEMPERATURE OF FURNACE OXIDIZED
VO₂ FOR SPACECRAFT THERMAL CONTROL**Abstract**

Vanadium dioxide is a thermochromic material which undergoes a drastic change in optical properties during its transition from an insulator at room temperature to a metal at high temperatures. Given this shift in optical properties, vanadium dioxide can be integrated into nanofabricated coatings to provide variable emittance for spacecraft thermal control. Previously we had designed a variable emitter that had a 0.40 change in total emissivity upon heating and the recently fabricated coating displayed a similar total emissivity change. Vanadium dioxide typically transitions near 68 deg C, so one key issue that still needs to be addressed for vanadium dioxide-based variable emitters is how to reduce the transition temperature to a level that is practical for robotic and human spacecraft missions.

In this work, we will introduce several techniques capable of significantly reducing the transition temperature for vanadium dioxide films that have been prepared via a furnace oxidation method. A 10 deg C reduction in transition temperature can be achieved simply by changing the furnace oxidation conditions. Also, an alumina buffer layer has also been demonstrated to lower the vanadium dioxide transition temperature by 5 deg C. Our current work is focused on obtaining a much lower transition temperature through co-sputtering the vanadium precursor film with tungsten, molybdenum, niobium, and other dopants. The doped films are then oxidized in an atmospheric tube furnace at low temperature (300 deg C) to produce stoichiometric vanadium dioxide. An alternative method also being explored is diffusing the dopants into the vanadium precursor film using a high temperature anneal in inert gas. Temperature-dependent FTIR measurements of the heating and cooling curves are taken to determine the transition temperature of the fabricated thin films. Moreover, the dielectric constant of the doped vanadium dioxide is fitted to the experimental data to facilitate coating design and modeling for variable emitters.