Specific Heats of Equilibrium and Supercooled $Ti_{39.5}Zr_{39.5}Ni_{21}$, $Zr_{64}Ni_{36}$, and $Cu_{50}Zr_{50}$ Liquids from Ground- and Space-Based Studies

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Measurements of thermophysical properties of high melting temperature metallic alloy liquids are difficult because of contamination/reaction with container materials. Moreover, container processing does not allow a liquid to be supercooled. Here, we present results from the specific heat measurements for $Ti_{39.5}Zr_{39.5}Ni_{21}$, $Zr_{64}Ni_{36}$, and $Cu_{50}Zr_{50}$ liquids in the equilibrium and supercooled states using levitation techniques. The first alloy solidifies into a quasicrystal, the second one is a marginal glass former which requires fast quenching, and the third one forms a bulk metallic glass with moderate cooling rates. The ground-based studies used the electrostatic levitation technique, while electromagnetic levitation on the international space station was used for the space-based studies. The total hemispherical emissivity, coupled with radiative heat loss measurements using the Stefan-Boltzmann relation, enabled the specific heat to be determined in the ground-based studies. A modulation calorimetry technique was used for the space-based studies. An increase in the specific heat with decreasing temperatures was observed for $Cu_{50}Zr_{50}$ and $Zr_{64}Ni_{36}$ liquids, while it decreased for $Ti_{39.5}Zr_{39.5}Ni_{21}$. These results will be discussed in the context of nucleation of crystal phases and glass formation.