The effect of temperature on density of solid metals

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It is reported that sound velocities of several solid metals show drastic non-linear reduction at near the melting temperature. This is called premelting effect. Nadal and Le Poac (2013) reported that the sound velocity (P-wave and S-wave velocities) of solid tin (Sn) decreased drastically just before melting (T/T_m ~0.99) at ambient pressure. They suggested that this decrease is due to reduction of elastic moduli (bulk and shear moduli). To understand the premelting effect more accurately, density data of tin near the melting temperature is also required in addition to sound velocity data. However, the precise density behavior of tin around the melting temperature is still missing. In this study, we measured the density of solid metals (tin and nickel) at ambient pressure and studied the effect of temperature on the density near melting temperature. The densities of solid metals were measured from optical image of the sample in the high-temperature furnace up to 673 K for Sn and 1873 K for fcc-Ni. The densities in this study were measured with error of 0.07 % for Sn and 0.4 % for Ni. Density of Sn decreases linearly with increasing temperature up to 490 K and reduced drastically above 490 K (at T/T_m~0.97). This drastic decrease in density of Sn is likely to relate to the premelting effect suggested from sound velocity measurement. In contrast, density of Ni decreases almost linearly with increasing temperature up to melting point and no drastic density change was observed in solid state.

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