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Crystal structure and thermal characteristics of Mn modified Ultra-high Curie temperature (> 800°C) Bi_2WO_6 piezoelectric ceramics

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Abstract: Searching low sintering temperature material with ultra-high Curie temperature (> 800°C) is urgent to seafloor hydrothermal vents detection. Bi_2WO_6 was first improved to possess ultra-high Curie temperature and ultra-high depolarization temperature by experiment. The $MnCO_3$ was selected as dopant materials due to its excellent effect on improvement of sintering abilities and piezoelectric properties. The density test shows that Mn addition can obviously improve the density of Bi_2WO_6 ceramics from 93.6 % to 97.76 %, and the grains also changed from round to layered. The crystal structure change with Mn addition was tested by synchrotron radiation and calculated by *ab initio* and Rietveld refinement. The symmetry group of ultra-high Curie temperature Bi_2WO_6 is Aba2 (41). The XAFS results show that Mn atom more likely at the Bi-site in the crystal structure of $Bi_2W_{1-x}Mn_xO_6$ and the Mn ion has the valence alternation. The Curie temperature of $Bi_2W_{1-x}Mn_xO_6$ with increasing x are 997 °C, 915 °C, 890 °C, 729 °C, respectively, and the depolarization temperatures are around 940 °C, 895 °C, 825 °C, and 700 °C, respectively. The results show that $Bi_2W_{1-x}Mn_xO_6$ ($x \leq 0.01$) ceramics are suitable for the ultra-high temperature applications of sensors or transducers on seafloor hydrothermal vents detection.

Keywords: Piezoelectric materials; Crystal structure; Synchrotron radiation; Thermal characteristic; Seafloor hydrothermal vents