Mn-BASED COMPOUNDS FOR MAGNETOCALORIC APPLICATIONS AT ROOM TEMPERATURE

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ABSTRACT

In the last decade, the magnetic refrigerant materials have extensively been studied and it has been recognized that the first-order magnetic transition (FOMT) systems showing giant magnetocaloric effects (MCEs) are promising candidates for magnetic refrigerant materials. Among them, the Mn-based compounds are fascinating materials, because (1) Mn atoms have large magnetic moments of $3 - 4 \mu_B$, which give large MCEs and (2) the Curie temperatures can be tuned by changing the compositions of constituent elements. The first-generation materials are MnAs$_{1-x}$Sb$_x$ with the NiAs-type structure and MnFeP$_{1-x}$As$_x$ with the Fe$_2$P-type structure [1,2]. Since these compounds contain a toxic element, they are hardly acceptable for practical applications. The second-generation materials, Mn$_{2-x}$Fe$_x$P$_{1-y}$Ge$_y$ and Mn$_{2-x}$Fe$_x$P$_{1-y}$Si$_y$, which are free from the toxic element, have been developed by Dr. E. Brück and his co-workers since 2005 [3,4]. These materials also undergo sharp FOMTs and exhibit excellent MCEs at around room temperature. However, the magnetic phase transition of these compounds depends on the heat treatment. Moreover, the compounds exhibit huge thermal hysteresis, when their Curie temperatures are near room temperature. In this talk, we will show our recent data on the effects of heat treatment and substitution of other elements on the magnetic transition and thermal hysteresis of Mn$_{2-x}$Fe$_x$P$_{1-y}$Ge$_y$ and Mn$_{2-x}$Fe$_x$P$_{1-y}$Si$_y$.

REFERENCES

[3] Dagula, W. et. al. 2005, Magnetic-entropy change in Mn$_{1.1}$Fe$_{0.9}$P$_{1-x}$Ge$_x$ compounds, IEEE Trans. Magn. 41: 2778-2780