INTERNATIONAL CONFERENCE ON f-ELEMENTS (ICFE-10)

Including rare earths (Y, Sc, lanthanides) and actinides

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ICFE-10

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PLENARY LECTURE

Clean thermal energy to electricity conversion thanks to rare Earth Zintl phases

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Thermoelectric devices for power generation convert thermal energy directly into electrical energy, require minimal maintenance, and can be operated over a large temperature range (room temperature to greater than 1000 ˚C). These devices are reliable and scalable power sources. There are a wide range of waste heat recovery applications, including automotive, solar renewable energy, and industrial processes. Zintl phases have been identified as a classification of compounds that provide efficient thermoelectric properties with the discovery of a high figure of merit, zT, at high temperatures for $Yb_{14}MnSb_{11}$ [1]. While the 2+ rare earths are expected to substitute into existing Zintl structures, the 3+ rare earths add additional complexity and allow for fine tuning and optimization of properties [2]. The crystal chemistry and structure-property relations of these new compounds will be highlighted along with a vision towards further optimization and other relevant applications [3].

[1] S. M. Kauzlarich, S. Brown, G. J. Snyder, Zintl phases for thermoelectric devices, *Dalton Transactions* (2007) 2099-2107.

[2] N. Kazem, S.M. Kauzlarich Thermoelectric Properties of Zintl Antimonides

Handbook on the Physics and Chemistry of Rare Earths, vol. 50, Elsevier (2016), p. 177-208

[3] Y. Hu, C.-W. Chen, H. Cao, F. Makhmudov, J. H. Grebenkemper, M.. N. Abdusalyamova, E. Morosan, S. M. Kauzlarich, Tuning Magnetism of $[MnSb_4]^{9-}$ Cluster in $Yb_{14}MnSb_{11}$ through Chemical Substitutions on Yb Sites: Appearance and Disappearance of Spin Reorientation, *Journal of the American Chemical Society* 138 (2016): 12422-12431.