

Seminar: Franca Albertini

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Tuesday, September, 29th 2026 at 11 am

Salle 4-A014, Institut Jean Lamour, Campus Artem

Thermomagnetic Energy Conversion Materials: from Heuslers to High Entropy Alloys



The development of thermomagnetic energy conversion technologies for low-grade heat recovery critically depends on materials with tailored properties. Key requirements include large magnetization changes at operational temperatures, high thermal diffusivity, and low specific and latent heat. Among the most promising candidates are Heusler alloys, widely studied for multicaloric refrigeration, which offer exceptional tunability of functional properties, making them ideal for thermomagnetic applications. Equally important is the exploration of novel material systems that may provide complementary or superior performance.

In this talk, I will present results on Heusler alloys exhibiting both first- and second-order transitions within relevant temperature ranges, synthesized in bulk form. Ribbons and thin films have also been prepared for potential integration into small-scale devices.

The second part of the talk will focus on new findings regarding rare-earth-free high-entropy alloys based on Fe-Ni-Ga-Mn-Si. Structural and magnetic characterizations reveal second-order Curie transitions near room temperature, aligning well with thermomagnetic device requirements. To evaluate their energy conversion potential, we performed calculations based on experimental magnetization data to estimate the magnetic work produced during ideal thermomagnetic cycles. These results are highly promising, with magnetic work values surpassing those of Gd when the hot source temperature exceeds 335 K. In-operando testing of these HEAs in a prototype thermomagnetic motor demonstrates high mechanical and electrical power outputs, outperforming previously reported values.

This project has received funding from the European Union under grant agreement No. 101119852.

Séminaire organisé par le Département Chimie et physique des surfaces et des solides