Séminaire du LCP-A2MC

Electronic transport of amorphous $Pd_{.76}Cu_{.06}Si_{.18}$ thin films. Effect of thickness and of an applied partial pressure of gaseous hydrogen on Absolute Thermoelectric Power.

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Summary: The **A**bsolute **T**hermoelectric **P**ower (**ATP**) of an alloy is an intrinsic property of a material, similar to electrical resistivity or magnetic susceptibility. It allows us to characterize the material, its phase transitions, and the changes (rapid or slow) in its microstructure. It provides information difficult or expensive to obtain using DSC, X-ray, neutron, or electron scattering (SEM, TEM, etc.).

Measuring the resistivity and **ATP** of metals was developed at the University of Lorraine. Our experimental setups, controlled by a LabView program written by one of us (F. G.), were initially designed to conduct fundamental research on liquid and solid alloys between -190°C and +1300°C. They are now used for phase transformations and their kinetics, particularly slow transformations (aging).

If the **TEP** (**T**hermo**E**lectric **P**ower) of a (thermo)couple is well known, the concept of **ATP** representative of a single material is less so. There are fewer scientific publications (about twenty times) using **ATP** than resistivity. Unlike resistivity, which requires knowing the exact geometry of the sample, often difficult to determine when the shape is complex, **ATP** has the advantage of being able to be measured directly. **ATP** is extracted from the measurement of the **TEP** of a couple, one leg of which consists of a known thermoelement, the second being the sample. Moreover, for metals, unlike semiconductors, the measured voltages are very low. It is necessary to use micro/nanovoltmeters and a suitable measurement method. Several devices are available on the market to measure high **TEP** (semiconductors), very few for the **ATP** of metals and for thin films.

A new device with an extreme accuracy was developed to measure thin layers from 3 to 300 nm elaborated by "magnetron sputtering" at Fraunhofer-ENAS Chemnitz (thicker materials can also be measured). This gave rise to a sensor of ultimate accuracy (~0.01mV/K) with a standard deviation of few nV/K (~2nV/K) that we describe. The **ATP** of amorphous $Pd_{.76}Cu_{.06}Si_{.18}$layers varies strongly with the thickness. We even observed that for certain crystalline alloys, the ATP could change sign for small thicknesses. For some alloys, **ATP** is a quantity that is sensitive to hydrogen adsorption and the electronic transport changes tremendously. When exposing the layers to gaseous hydrogen (partial pressure of 0 to 0.05 bar), the **ATP** is strongly modified. Working on samples of the order of 100,000 times thinner (3 to 300nm) than a usual metallic sheet, allowed us to improve the measurement time by the same coefficient. We simultaneously developed a device for resistivity thin films, but it has not yet been systematically used with hydrogen.

Keywords: Resistivity, "**A**bsolute **T**hermoelectric **P**ower", "Thin films", Metrology, Hydrogen.

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