**PPMS**

**Equipment:** PPMS (Physical-Properties-Measurement-System)

**No. of Equipment: UPOL2**

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**Equipment Description**

**Description of equipment:**

Compare to SQUID, the physical properties measurement system (PPMS) is a more complex device allows to operator a broad option of measurements including magnetic properties, electro-transport properties and thermal properties. Regarding magnetic properties, PPMS using a vibrating sample magnetometer (VSM) which is less sensitive than SQUID and provide only DC (direct current) measurement option. On the other hand, measurement is taking shorter and thanks to broader options of measurement one can complete magnetic information from VSM with data from thermal measurement, namely from heat capacity. Heat capacity measurement enriches information about magnetic ordering transition given magnetic transition enthalpy and entropy. Using of external magnetic field during heat capacity measurements provides monitoring of magnetocaloric effect or magnetic anisotropy in molecular complexes. The Electrical Transport Option (ETO) enables users to make several different types of transport measurements over a wide range of resistance values and sample types. The ETO supports three types of measurements including resistivity, IV curves and differential resistance. Measurements are usually made by applying a sinusoidal AC (alternating current) drive current and measuring the AC voltage response. However, a special 2-wire high resistance mode is available where an AC voltage is applied and the AC current response is measured with a current amplifier. The current source has a minimum precision of 1 nA and a maximum current of 100 mA. It is capable of supplying both DC and AC current with frequencies from 0.1 Hz to 200 Hz. The preamplifiers consist of a high gain amplifier, a programmable gain amplifier, and a high impedance (current) amplifier. These three preamps, in conjunction with the current source, give the ETO a noise floor of 10 nΩ and allow measurement of resistances up to 5 GΩ.

The samples form for PPMS measurement depends on measuring option. Powders and pellets are preferred in the case of magnetic and thermal transport measurements, while alloys are suitable for electro transport measurements. The PPMS offers a wide range of temperatures from 1.9 K – 400 K and the presence of external magnetic field ranging from -9 T to +9 T.

**Specification of expertise relevant to NanoEnviCz workpackages:**

**WP3**a,c-f,h, **WP4**a,b **WP5**c, **WP6**a,f **WP7**a-i, **WP8**a-f,

**Detailed description of expertise**

**Please, specify the main research topics connected with equipment**:

Magnetism, magnetic properties

**Please, specify the secondary research topics connected with equipment**:

Electric properties, conductivity measurements, transport properties

**Keywords describing research area:** nanoparticles, magnetism, conductivity, thermal capacity

**Competence**

**Relevance for applied and industrial research:**

PPMS offer a broad spectrum of measurements starting with magnetic characterization, followed by estimation of thermal behavior emphasizing on heat capacity characteristics. Last, but not least the electro-transport properties such as IV characteristics or resistivity helps with resolving many issues in industrial areas.

**Relevance for fundamental studies:**

PPMS is a key technique for many fundamental studies due to possibility of extract either magnetic or thermal properties on single prepared sample. Moreover, if there is an option of sintering or pressing the sample to the pellet, the electro-transport properties can be obtained.