Application Note CI02

# Performance Test of the ANPz30/LT at 35 mK and 15 Tesla

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The precise performance of nanopositioning elements is of great importance in order to realize instrumental setups which work reliably under extreme environmental conditions. Although attocube systems' positioners have been tested at low temperatures down to 10 mK and at high magnetic fields up to 28 Tesla, their successful performance has never been demonstrated when both environmental conditions were simultaneously applied. A real challenge, furthermore, is to carry out such a test in a 3He/4He environment due to the fact that 3He carries a magnetic spin which becomes polarized in magnetic fields. This influence on the positioner's operation has so far not been investigated. Furthermore, the required low-resistive wiring of the positioners becomes challenging under these conditions.

Due to the size of the ANPz30 positioner (see Figure 1), the heat input is considered to be very low which makes these units particularly suitable for the application in the mK range. The experiments were performed in a commercially available top-loading cryostat equipped with a 18 T magnet. The cooling power at $T$ = 100 mK is 370 µW and the base temperature without any insert is around 12 mK. In order to confirm the movement of the positioner a small switch was placed on top of the ANPz30/LT which was activated after a travelled distance of 1 mm. For the wiring, a twisted pair of copper wires with a diameter of 90 µm were used for the most part, but from the 1K–pot downwards NbTi–superconducting wires were applied in order to reduce heat leakage via the copper wires. With the inserted setup as shown in Figure 2a base temperature of 35 mK was reached. Two different temperature sensors have been applied to monitor the possible warming up of the 3He/4He–mixture when operating the ANPz30/LT.

The experiments reveal that the stepper positioner works reliably when applying both, temperatures in the low mK regime and magnetic fields up to 15 Tesla. Exemplary, Figure 3 shows the temperature measured before ($T_{7,START}$) and after ($T_{7,END}$) moving the positioner downwards for 30 sec. The jump in temperature which is observed when the field changes from $B$ = 0 T to 1 T is due to the high current in the leads of the superconducting magnet. The plot clearly shows, that operating the positioner at any field does not affect the base temperature, that means almost no or only little heat is produced. Furthermore, no considerable heat release was detected when moving the positioner even when the step frequency was increased up to 73 Hz.

These successful tests open up the door to a wide range of new cryomagnetic experiments and applications.

***Figure 1:*** *Photo of the ANPz30, the smallest positioner offered by attocube systems providing high resolution z-positioning over 2.5 mm.*

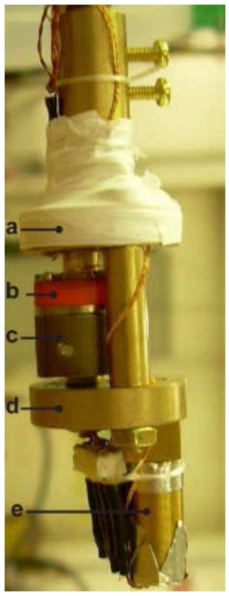


***Figure 2:*** *Photo of the Setup:*
*(a) upper platform with heater and thermometer*
*(b) plastic disc*
*(c) ANPz30/LT movable platform*
*(d) lower platform*
*(e) second thermometer*

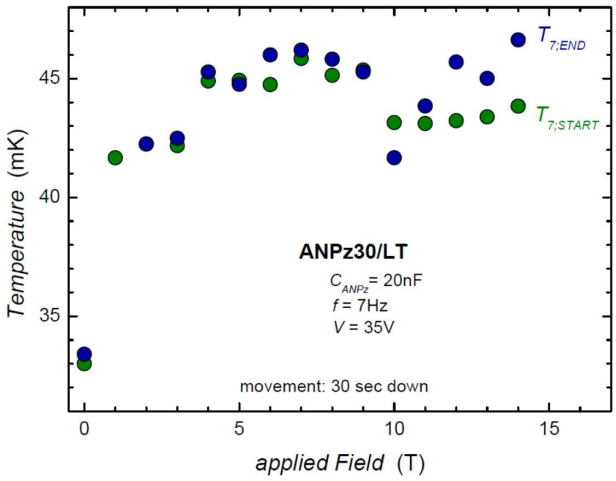


***Figure 3:*** *Heat release due to the downwards motion t = 30 sec at base temperature in various magnetic fields.*

(The data was generously provided by Dr. J. Custers from the Institute for Solid State Physics, Vienna University of Technology, Austria.)