The measurement of angle-resolved thermoelectric power in a layered organic conductor, κ-(BEDT-TTF)$_2$Cu(NCS)$_2$

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In general, electronic properties in solids have anisotropy. In this sense, when one measures some kinds of physical properties one should investigate them with taking account of their angle dependence. On the contrary, one can often obtain the important information through determining the anisotropy. From this requirement, we have been developed a new method of measuring the angle dependence of physical properties. By making use of the advantage of organic metals for thermoelectric effect, we constructed the method of measuring the angle-resolved thermoelectric power.

Figure 1 shows a conceptual drawing of the measuring system. An electrode is attached to the center of a disk-shaped crystal and 16 electrodes are attached on top surfaces of the crystal near the side faces. Temperature difference, ΔT, is generated along the r direction in the polar coordinate (r θ) by heating the base electrode. The induced thermoelectric power, $V=V_n-V_0$, is measured as a function of n where n=1-16. Thus, θ-dependence of thermoelectric power can be deduced in this method.

Figure 2 displays a result obtained in a layered organic crystal κ-(BEDT-TTF)$_2$Cu(NCS)$_2$. This material shows a sign change of thermoelectric power when the direction of heat current is rotated[1]. Obtained results reproduce well this characteristic angle dependence although large positive voltage, which originate from the thermoelectric power of lead wires and must be θ-independent, is convoluted. Indeed a fitting of the data by using a sin function give a cycle period as 180.2 degree, which is excellently consistent with the theoretical value (180 degree). In this way, we successfully measured thermoelectric power as a function of the heat-flow direction in an identical crystal.

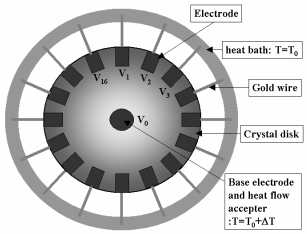

Fig.1. A schematic drawing of a measuring system of angle-resolved thermoelectric power.

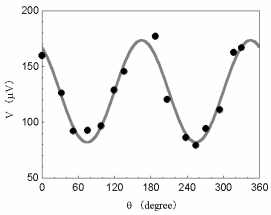

Fig.2. θ-dependence of thermoelectric power of κ-(BEDT-TTF)$_2$Cu(NCS)$_2$ at room temperature .

[1] T. Mori and H. Inokuchi, J. Phys. Soc. Jpn. **57**, 3674 (1988)