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Magnetic field-induced phase transitions and possible new quantum hall effect in quasi-one-dimensional organic conductor, HMTSF-TCNQ

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It is well-known that the first organic superconductor, $(TMTSF)_2PF_6$ undergoes a spin density wave (SDW) insulating state at low pressure. By increasing pressure, SDW is suppressed and 1 K-superconductivity appears at the critical pressure Pc of 0.65 GPa. Further increase of pressure realizes a simple metallic state. Only around the pressure Pc, magnetic field induced phases appear successively, which are called field-induced SDW (FISDW). What is more fascinating is that these phases exhibit quantum Hall effect (QHE). These are phenomena, only observed at the quantum critical point of SDW system. It is very much attracted to see whether or not the similar effects are seen in the charge density wave (CDW) system.

By survey, HMTSF-TCNQ, hexamethylenetetraselenafulvalene-tetracyano-quinodiethane, is a typical conductor of CDW, which is suppressed at the pressure of 1 GPa. Tuning the pressure to this value, magnetic field up to 31 Tesla in National High Magnetic Field/FSU with the sample temperature between 0.3 - 4.2 K was applied. Magnetoresistance, angular dependence of magnetoresistance, and Hall resistances (R_{xy}) were studied.

It turned out that the field-induced phases, probably FICDW, were actually present when magnetic field was applied in a specific direction against the crystal axes in a wide range of magnetic field (0.2 T - 10 T). It showed a plateau structure in the same field region, which is suggestive of the presence of QHE. Beyond 10 T of magnetic field, extremely insulating phase appears which might be due to quantum limit of Landau orbits, which was realized by the imperfect nesting of Fermi surface in the phases of FICDW.

Biography

Keizo Murata has completed his PhD at the age of 27 years from the University of Tokyo, and became a Research Staff at Electrotechnical Laboratory, AIST. He found an increase of superconductivity of organic conductor by about 10 under high pressure in 1985. He was engaged in Osaka City University as a Professor of Physics from 1996. He has published more than 300 papers in reputed journals and serving as an editorial board member of J. Physical Society of Japan. He edited a book on high pressure technique (432 pages) and is one of the chief members of high pressure society in Japan.

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