Nano-size Molecular Conductors Directly Formed on Silicon Substrates

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Nano-size crystals of the molecular conductors have been directly formed on SiO2/Si substrates. Two kinds of methods were used for this on-site crystal growth, one of which is the electrochemical crystallization on the electrodes prepared on the substrate, and the other of which is the direct reaction of metal cupper or silver with acceptor molecules such as DCNQI (= N,N'-Dicyanobenzoquinonediimine) derivatives on the substrate. Both processes were performed in solutions containing the precursors of the molecular conductors, namely donor or acceptor molecules. In both cases, we have succeeded in bridging two or more electrodes with single crystal of the molecular conductor as shown in the SEM photograph below. Thus two-probe and/or four-probe conductivity measurements were performed on various kinds of molecular conductors such as (BEDT-TTF)2I3, (BEDT-TTF)2Cu[N(CN)2]Br, (EDT-TTF)4BrI2(TIE)5, (EDO-TTF)2PF6, and (DMe-DCNQI-d7)Cu etc. (BEDT-TTF = bisethylenedithiotetrathiafulvalene; EDT-TTF = ethylenedithiotetrathiafulvalene) The temperature dependence of the resisitivity often exhibited significantly different behaviors from the corresponding bulk crystal.

The two wet processes we have developed to fabricate conductive molecular devices on silicon substrate as above are easy, fast, convenient, and low-cost processes, so that they should open the way not only to the scientific research on the molecular conductors but also to their application use as electric devices.