A FIELD EFFECT TRANSISTOR DEVICE BASED UPON THE CHARGE DENSITY WAVE MATERIAL $Per_2Au(mnt)_2$

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We report preliminary measurements of a Field Effect Transistor (FET) device based on the Charge Density Wave (CDW) material $Per_2Au(mnt)_2$. The device consists of a source and drain electrode (ohmic contacts at either end of the $Per_2Au(mnt)_2$ sample) and a central gate electrode electrically isolated from the sample by a thin insulating buffer layer (Figure 1.)

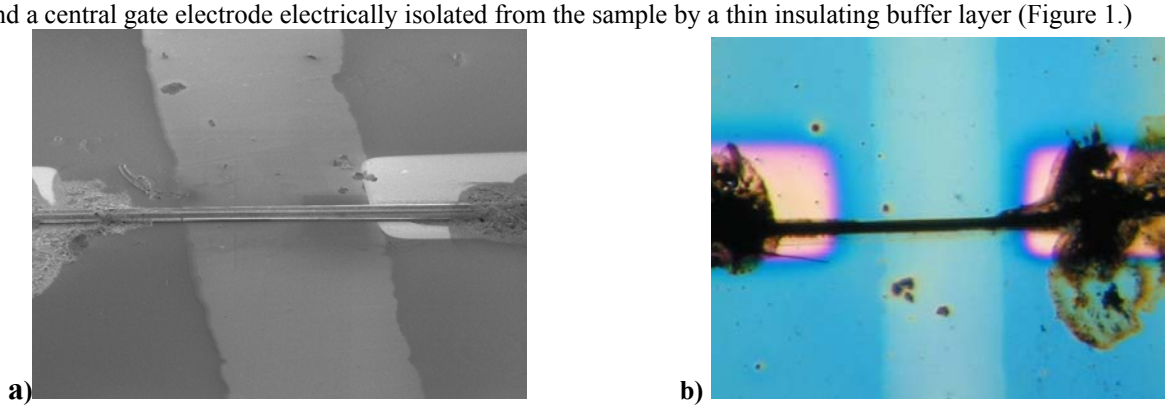

Figure 1a: An oblique angle SEM image of the $Per_2Au(mnt)_2$ CDW device with Clarex substrate. The $Per_2Au(mnt)_2$ sample is approximately 60 micrometers wide and runs from left to right between the gold source and drain contacts. The light grey central region is the gate electrode, which electrically isolated from the sample by a PMMA buffer layer.
b: An optical image of a similar device. The blue appearance of the gate electrode indicates the optical thickness of the PMMA buffer layer to be 400-500 nm

$Per_2Au(mnt)_2$ undergoes a CDW transition at a temperature of 12 K, below which it is a fully gapped insulator. The interest in using this material as the active region of a FET stems not only from the possibility of influencing the conductivity via injection of charge but also the CDW's highly nonlinear electric field response and the potential perturb the inherent CDW periodicity with a periodic gate electrode [1]. Here we report the important first step in this research, which is to demonstrate the effect of a gate electric field upon the source-drain resistance (see Figure2). The resistance was measured with a standard AC lock in technique whilst a DC voltage was applied between the gate and drain.

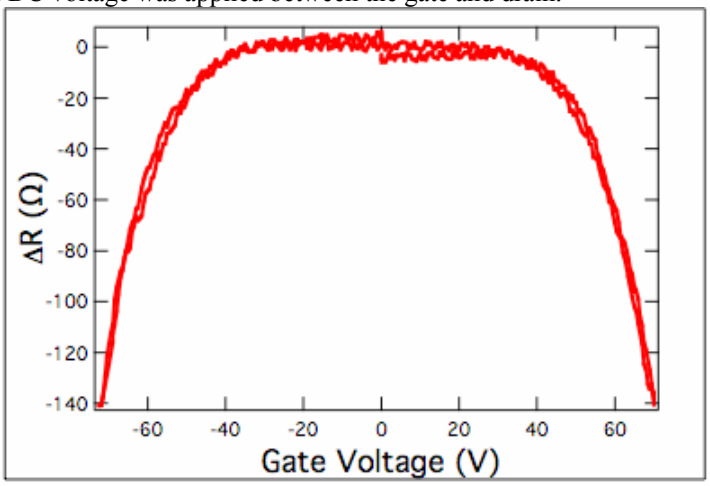

Figure 2: The change in source-drain resistance as a function of gate voltage, measured at a temperature of 4 K with a source-drain current of 100 nA. A clear and reversible switching effect is observed at around a gate voltage of ±40 V.

References

[1] Harrison N., *et al*., "Quantum coherent switch utilizing commensurate nanoelectrode and charge density periodicities", US patent 60/485,370 (2003). Converted to full patent July 2004.