

Progress report (Aug 2010)

1. Introduction

Recently, I have cooperated with Kawasugi-san to make planar-type spin valve based on pentacene single crystals. This device is expected to have better performance due to the high electric mobility (up to $40\text{cm}^2\text{V}^{-1}\text{s}^{-1}$) and has ability to apply non-local geometry for measuring spin accumulation.

In the first step, we would like to check the working of spin valve based on pentacene single crystals on the LSMO electrodes.

2. Experiments

In this work, we used half-metallic LSMO films grown epitaxially on STO by pulsed laser deposition. LSMO films with a thickness of approximately 100 nm were patterned on a pair of rectangular electrodes by electron-beam lithography and dry etching. The gap between the electrodes was in the range about few hundred nanometers.

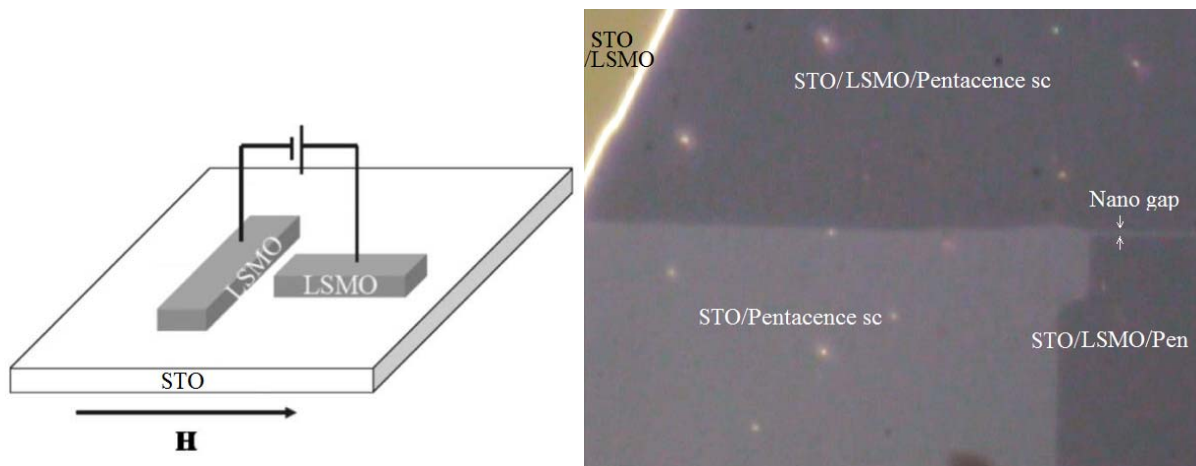


Figure 1: Schematic illustration of LSMO electrodes on STO substrate (left) and image of STO/LSMO/sc-Pentacene spin-valve.

The pentacene single crystals were fabricated using physical vapour transport method (at 270°C and nitrogen flow of 100 ml/min), which can grow the plate-like crystals with the area up to $0.5\text{-}1\text{ cm}^2$. We used to choose the crystals with the area of $1\text{-}2\text{ mm}^2$ and thickness of few micrometers to laminate on the STO/LSMO substrate.

3. Results

The MR effect is clearly observed with ratio up to $\sim 35\%$ at 6K and bias voltage of 20mV, which qualitatively agrees with device based on thin film (T.Ikegami-san work). The detail results are shown below.

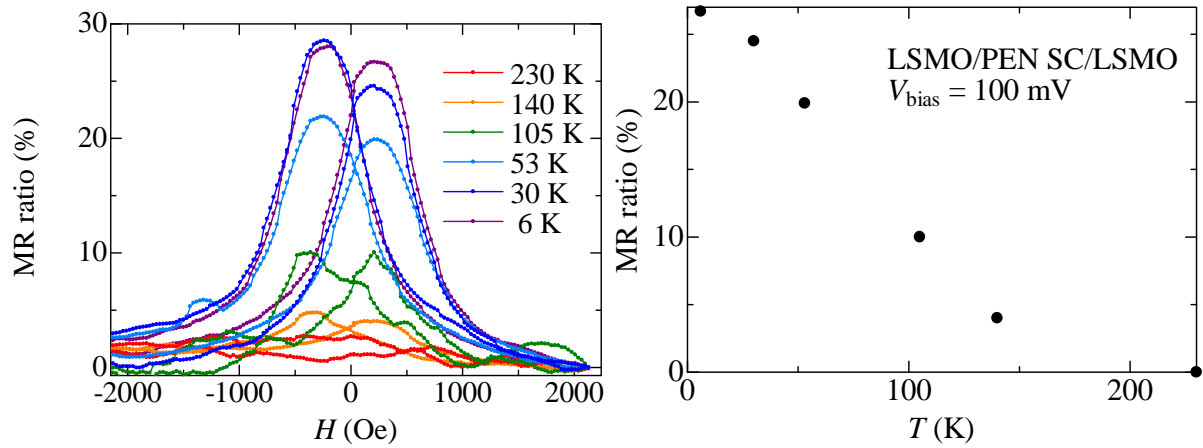


Figure 2: MR curve of sc-pentacene spin-valve (left) and the dependence of MR ratio to temperature at the bias voltage of 100mV (right).

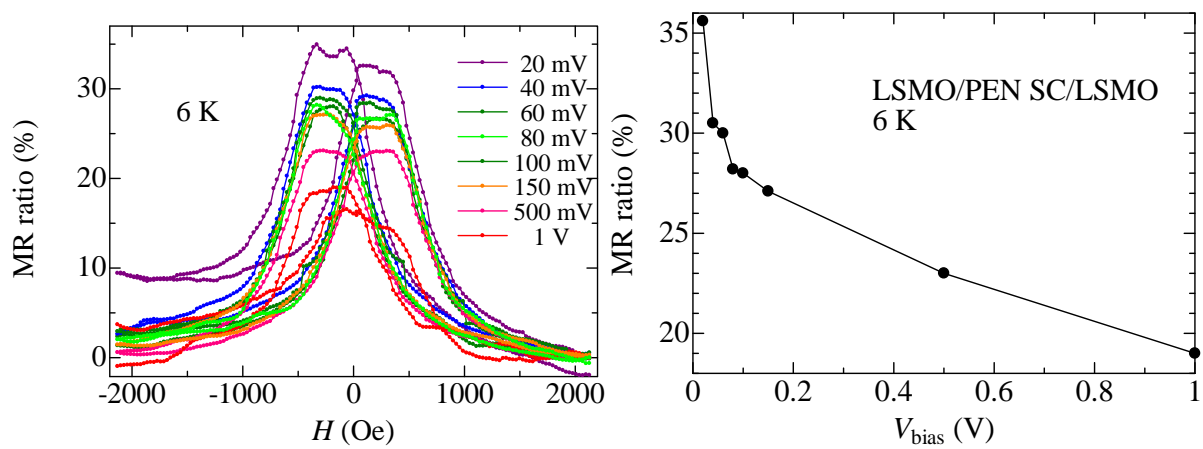


Figure 3: MR curve of sc-pentacene spin-valve (left) and the dependence of MR ratio to bias voltage at 6K (right).

4. Future plans

Our next work is to measure devices having pair parallel electrodes with different width, which can be used for non-local geometry measurement. After that, we will try some measurements like MR ratio depended on mobility of sc pentacene or spin accumulation ...