**Sample Wiring**

1. Is a smaller sample or a larger sample better for resistance measurements (suppose you lock the aspect ratio)?
2. When you apply magnetic field (out-of-plane direction), is the change in resistance magnetoresistance or 1/magnetoconductance?

Classically, according to Drude transport (see Ashcroft and Mermin Ch. 1)

$$ρ\_{xx}=\frac{1}{neμ}=constant and 1/σ\_{xx}=(1+μ^{2}B^{2})\frac{1}{neμ}$$

 Is the measured R proportional to $ρ\_{xx}$ or R proportional to $1/σ\_{xx}$?

1. Draw how the current flows in the following geometry when the magnetic field is applied out-of-plane.

(a)

(b)

1. In (a), what happens if you put the V+ and V- closer?

1. In (b), what happens if the size of the voltage contacts is bigger?

**Lock-in Measurements**

1. Setup a two-terminal resistance measurement configuration.
2. Complete the two-terminal measurements.

Check if I and V scale linearly, frequency dependence.

|  |  |  |  |
| --- | --- | --- | --- |
| Ω | 4 | 3 | 2 |
| 1 |  |  |  |
| 2 |  |  |  |
| 3 |  |  |  |

1. What is the origin of the two terminal resistances? Would you continue the experiment if any of the resistance values are significantly larger or non-Ohmic?
2. Setup the lock-in for a four-terminal resistance measurement.
3. What is R3, 4; 5, 6 = V5,6/I3,4 ? Check if I and V scale linearly, check frequency dependence.
4. If you are going to measure R vs T or R vs H, what current, frequency, time constant, sensitivity, etc settings will you choose?
5. If you choose a time constant that is too short, what happens? Are the fluctuations noise? Try changing the excitation frequency and see what happens.
6. Measure R3,4, 6,5 ? Is it the same as -R3,4;5,6? If not, what can be the possible reason?