

// NON-INVASIVE FOUR-POINT PROBE MEASUREMENT

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Forschungszentrum Jülich GmbH

Jörg Bohnemann
+49 2461/61-5711
j.bohnemann@fz-juelich.de
www.fz-juelich.de

BACKGROUND

Four-terminal sensing and four-point probe methods are widely used measurement techniques which allow to determine the electrical resistance of a sample. In contrast to classical two-terminal measurements, this technique eliminates lead and contact resistances from measurements and thereby allows the measurement of resistances with higher accuracy. We hereby introduce an innovative improvement of the four-point probe measurement Setup.

Forschungszentrum Jülich has extensive expertise in this field and holds several patents. The technology described above is continuously being developed further. The Peter Grünberg Institute (PGI-3) – Functional Nanostructures at Surfaces – already cooperates with numerous national and international companies and scientific partners. The measurement capabilities resulting from the invention presented above have already been demonstrated. We are continuously seeking for cooperation partners and/or licensees in this and adjacent areas of research and application.

DEVELOPMENT STATUS

Laboratory model

PROBLEM

Previously reported implementations of four-point probe measurements, e.g. into a multi-tip scanning tunnelling microscope (STM), require two different kinds of electronics for current and voltage sensing, respectively. As a result, in order to approach the tips to the sample surface and to exchange contacts during four-probe measurements, the tips have to be rewired to the different electronics in between measurements. Those measurement setups lead to bulky, complex electronics and introduce additional noise to the measurements due to the additional circuitry.

CATEGORIES

//Electronic circuits
//Nanotechnology //Instrumentation and controls engineering technology //Sensor systems technology and measuring instruments //Materials science and engineering //Physical sciences //Electronics and electrical engineering //Surface engineering

SOLUTION

The technology features a simplified design of the electronics for non-invasive measurement experiments. Therefore, it minimizes or prevents various systematic errors in four-point measurement of resistance. For this purpose, measurements are carried out using four instances of identical electronics which can perform both, voltage and current measurements, including a relay for switching. During the measurement, the distance between sample and

measuring tip can be kept constant and the noise of the measurement signals can be reduced significantly.

SCOPE OF APPLICATION

Due to their high accuracy, four-point probe measurements are often used in fundamental research such as (low temperature) transport measurements, where the sample under investigation is typically contacted by lithographic contacts, monolithic four-point probes or a multi-tip STM. The technology in principle allows truly non-invasive four-probe measurements, which can be advantageous e.g. for the characterization of fragile samples.
