Low Temperature Kelvin Probe Force Microscopy of Multi-Quantum Well Solar Cells

Th. Glatzel[1], A. Schwarzman[2], E. Grünbaum[2], K. Barnham[3], M. Mazzer[3], M.Ch. Lux-Steiner[1], Y. Rosenwaks[2]

[1] Hahn-Meitner-Institut, Dep. Solar Energy, Glienicker Str. 100, 14109 Berlin, Germany
[2] Tel-Aviv University, Faculty of Engineering, Ramat Aviv, 69978, Israel
[3] Imperial College London, Experimental Solid State Physics, London SW7 2AZ, UK

We report on ultrahigh vacuum Kelvin Probe Force Microscopy (UHV - KPFM) measurements at low temperature of in-situ cleaved GaAs quantum well (QW) structures used for photovoltaic application.

The strain-balanced GaAsP/InGaAs quantum well solar cells (20 QWs, each 7.5 nm) are known to enhance the output current and efficiency compared to conventional GaAs cells [1]. The high resolution and potential sensitivity provided by the UHV - KPFM is known to be a powerful instrument for interface and surface characterization [2, 3]. In this contribution we present for the first time the UHV - KPFM measurement of the surface potential of individual QW as narrow as 7.5 nm (Fig.1) at various temperatures (30 K-295 K). The experimentally obtained potential profiles were found to be in a good agreement with numerical simulations of the surface potential distribution including a three-dimensional tip-sample electrostatic interaction.

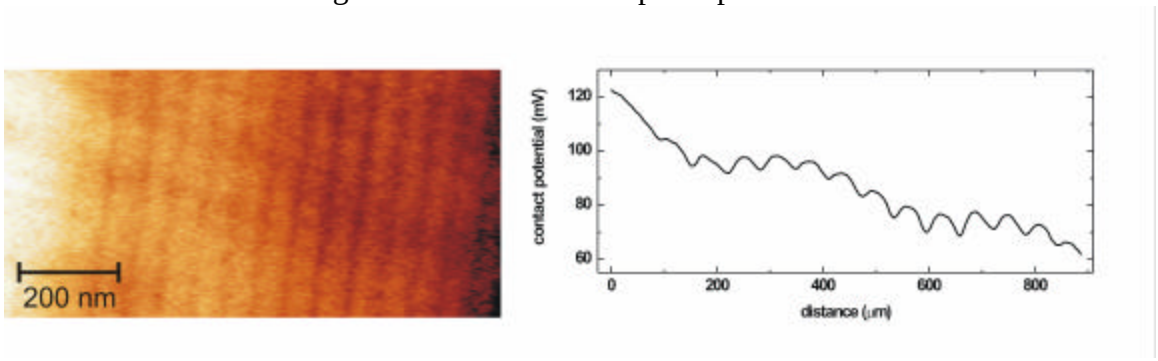

Figure 1: Contact potential image of a GaAs multi-quantum well structure with 20 InGaAs quantum wells each 7.5 nm measured by UHV-KPFM at a temperature of T˜ 30 K. The contrast represents a potential variation of CP = 20…160 mV. The averaged linescan across the QWs shows a reduced contact potential (˜ 5 mV) at the position of the QWs.

[1] K.W.J. Barnham, I. Ballard, J.G. Connolly, N. Ekins-Daukes, B.G. Kluftinger, J. Nelson, C. Rohr, M. Mazzer, J. Mat. Sci.: Mat. Elec. **11**, 531 (2000).

[2] Th. Glatzel, D. Fuertes Marrón, Th. Schedel-Niedrig, S. Sadewasser, M.Ch. Lux-Steiner, Appl. Phys. Lett. **81(11)**, 2017 (2002).

[3] Ch. Sommerhalter, Th.W. Matthes, Th. Glatzel, A. Jäger-Waldau, and M.Ch. Lux-Steiner, Appl. Phys. Lett. **75(2)**, 286 (1999).