Unexpected high conductivity at twin boundaries in LSMO thin films

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High quality $La_{2/3}Sr_{2/3}MnO_3$ thin films prepared by sputtering are studied by Conducting Scanning Force and Magnetic Force Microscopy. Film surface consists of one unit cell steps separating atomically flat terraces, with a surface roughness on the terraces lower than 0.3Å. In spite of the extremely flat surface morphology observed, simultaneously acquired topography and current maps revealed a considerably intensity along lines superimposed on a uniform current background. These enhanced conducting lines were not randomly distributed but forming domains with periodic arrays with perpendicular orientations. Line periodicity within each domain coincides with the lateral size of each crystallographic twin as observed by XRD and SEM, thus confirm that the observed lines correspond to the precise position of the twin boundaries. I-V characteristics indicate an important enhancement of the electronic response at the twin boundaries locations. Values of the measured current for a given voltage may differ by one order of magnitude. A clear magnetic signature is also detected at the twin boundaries locations. The origin of this large difference is still under consideration, but it seems that an increase in the density of states at the boundaries might have an important contribution.