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**Negative TMR in Magnetic Tunneling Junctions with Zr oxide barrier** TAKAHIRO MORIYAMA, WEIGANG WANG, XIAOHAI XIANG, JOHN XIAO, University of Delaware, TAO ZHU, Chinese Academy of Science, FEI-FEI LI, JUN DU, MING-WEN XIAO, ZHENG-ZHONG LI, AN HU, Nanjing University, UNIVERSITY OF DELAWARE TEAM — Negative Tunneling Magnetoresistance (TMR) was observed in Magnetic Tunnel Junctions (MTJs) with $AlO_x/ZrO_x$ and $ZrO_x/AlO_x$ hybrid barrier. The TMR shows a strong asymmetric bias dependence and changes from 8% at around zero bias to -4% at a high bias. The critical bias voltage ($V_c$) at which the TMR changes from positive to negative decreases with increasing the thickness of $ZrO_x$ layer. The MTJs were prepared by using magnetron sputtering system. The barriers were formed by two-step oxidation process. The structures of the MTJs are Si/FeNi/Cu/FeMn/Co/Barrier/Co/Cu (Barrier: $AlO_x/ZrO_x$, $ZrO_x/AlO_x$ or $AlO_x$). The observation of negative TMR at high bias was originally explained by using reversed majority and minority spin-DOS. However those explanations ignore the barrier shape such as barrier height and width which effectively contribute to the conductance at high bias. In this study, we point out that the negative TMR at high bias is due to not only the energy dependence of spin-DOS but also the barrier shape of the MTJs. Furthermore the mechanism for the negative TMR at high bias is quite different from that responsible for the negative TMR in low bias range.

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