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Tunneling magnetoresistance oscillation effect in double-barrier magnetic tunnel junctions

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In this work, we present the fabrication of the double barrier magnetic tunnel junction (DBMTJ) of Ta (5 nm)/Cu (30 nm)/$Ni_{79}Fe_{21}$(10 nm)/$Ir_{22}Mn_{78}$(12 nm)/$Co_{75}Fe_{25}$(4 nm)/Ru(0.9 nm)/$Co_{75}Fe_{25}$ (4 nm) /Al(1 nm)-oxide/$Co_{75}Fe_{25}$ (1 nm)/ $Ni_{79}Fe_{21}$ (2 nm)/ $Co_{75}Fe_{25}$ (1 nm)/Al(1 nm)- oxide/ $Co_{75}Fe_{25}$ (4 nm)/Ru(0.9 nm)/$Co_{75}Fe_{25}$ (4 nm) / $Ir_{22}Mn_{78}$ (12 nm)/ $Ni_{79}Fe_{21}$ (10 nm)/Cu(30 nm)/Ta(5 nm) on Si/SiO_2 wafer using Magnetron Sputtering System. Lithographic technique combined with Ar ion-beam etching was adopted in the micro-fabrication processes. Active area of a patterned elliptic DBMTJ element was 3x6π μm^2. Thus, TMR ratio of 27% and 42.2%, and resistance-area product RS of around 13.6 and 17.5 k$\Omega\mu m^2$ at 300 K and 4.2 K were obtained respectively. A tunneling magnetoresistance oscillation phenomenon with respect to the bias voltage was first observed in this experiment. Such an effect can be attributed to either the spin-polarized electron coherent and resonant tunneling or the quantum well states. It may open up the possibility of developing novel spintronic devices such as resonant-tunneling spin transistors, etc.