Seebeck effect in noncollinear double planar tunnel junctions with ferromagnetic electrodes and central layer separated by nonmagnetic barriers

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The Seebeck effect is investigated in double planar tunnel junctions consisting of ferromagnetic electrodes and the central ferromagnetic layer separated by nonmagnetic barriers. It is assumed that the magnetic moments in the central layer can form the arbitrary angle with the magnetic moments in the external electrodes. The calculations are performed in the linear response theory using the free-electron model. The Seebeck coefficient is calculated as a function of the thickness of the central layer and the average temperature of the junction. The influence of the relative orientation of the magnetic moments in the external electrodes and the central layer on this coefficient is also analysed. It has been found that the Seebeck coefficient oscillates with thickness of the central layer and can be enhanced in the junction with special central layer thickness due to electron tunneling by resonant states. The form of the observed oscillations varies with the temperature of the junction. The change of the central layer thickness leads to modification of the dependence of the Seebeck coefficient on the angle between magnetic moments in the central layer and the external electrodes.