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Superconducting/ferromagnetic proximity effect mediated by Cr spacer layers

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Abstract

We have studied the superconducting proximity effect in the thin film system Fe/Cr/V/Cr/Fe where the Cr layers play the role of screening layers between the superconducting V-layer and the strongly pair breaking Fe-layers. When keeping the thickness of the Fe-layers d_{Fe} fixed and varying the thickness of the Cr-layers d_{Cr} , the superconducting transition temperature T_c first rises reaching a maximum at $d_{Cr}=40 \text{ \AA}$ and then sharply drops for larger Cr-thickness. Keeping d_{Cr} constant and varying d_{Fe} the superconducting transition temperature becomes independent on d_{Fe} for $d_{Cr}>40 \text{ \AA}$. The results demonstrate that the Cooper pairs penetrate into the Cr-layer to a depth of about 40 \AA . From our experimental results we suggest that the Cr-layer is nonmagnetic for $d_{Cr}<40 \text{ \AA}$ and undergoes a transition to an incommensurate spin density wave state for $d_{Cr}>40 \text{ \AA}$.

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