Andreev spin-polarized tunneling through a quantum dot interacting with phonons

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Using the nonequlibrium Green-function technique we study theoretically spin-polarized transport due to Andreev reflection (AR) in a hybrid ferromagnet-quantum dot-superconductor junction based on a single-level quantum dot interacting with a local phonon mode. Phonon spectra have been calculated for arbitrary Coulomb correlations on the dot. The phonon-assisted AR phenomenon is analyzed within the Green function approach based on the dot correlators including both hole and electron contributions. Thus, it is shown that the phonon emission satellites in density of states spectrum calculated for the Andreev transmission may appear on both sides of the main resonance peaks corresponding to the quantum dot energy levels. The effect of the intradot Coulomb correlations on behavior of the conductance is shown for phonon-assisted AR transmission in the linear regime of bias voltage as well as in the nonequilibrium situation. In particular it is shown that the Franck-Condon blockade gives rise to a suppression of the transmission through the Andreev bound states in the linear bias voltage regime and may lead to a significant enhancement of the phonon resonances. In nonequilibrium situation, an effect of competition between intradot Coulomb correlations and the phonon field on the resonances in the differential conductance is discussed. An influence of the vibrational modes on the matching condition for the perfect AR phenomenon is analyzed as well. The numerical results obtained by means of different approximations of the Green-function correlators for the dot interacting with a local phonon mode are compared and discussed in detail.