Advancing the superconducting transition temperature ($T_c$) has been one of the major driving forces in superconductivity research ever since its discovery 100 years ago. The holistic multidisciplinary empirical approach to higher $T_c$ may be proven most fruitful and depends on imagination, insight, experience, and knowledge from different fields plus courage and luck. Two general steps have been adopted: to discover new compounds guided by experience and insight empirically and to realize novel mechanisms inspired by models theoretically. Until now, successes have come almost exclusively from the former. Of the many theoretical mechanisms proposed, few have led to the discovery of a superconductor with a clear enhanced-$T_c$. Interfacial mechanism has been one such most explored theoretically and experimentally but without clear evidence for an enhanced $T_c$. Our recent detection [1] of non-bulk superconductivity with an unexpectedly high onset-$T_c$ up to 49 K in rare-earth-doped CaFe$_2$As$_2$ (Ca122) single crystals, which is higher than that in known compounds consisting of any combination of the constituent elements, affords an opportunity for the study. Through systematic structural and magnetic investigations, we have shown [2] the existence of nano-2D structures in the chemically homogeneous rare-earth doped Ca122 single crystals and thus provided evidence for the possible interface-enhanced $T_c$ in Fe-based superconductors. Such nano-structures may be attributed to defects as evident from the presence of superparamagnetism [3] in these superconducting samples.