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Testing the limits for critical currents in YBa$_2$Cu$_3$O$_7$ films
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Vortex pinning in YBa$_2$Cu$_3$O$_7$ films can be very strong. At low temperatures and
in the absence of applied magnetic field ($H$), critical current densities $J_c$ of about
20% of the depairing limit have been obtained. This is as high as the best achieved
in commercial Nb-based superconducting wires after decades of optimization. Re-
markably, similar $J_c$s are attained in YBa$_2$Cu$_3$O$_7$ films grown by various methods
that produce vastly different nanostructures, suggesting that perhaps we are close
to an effective $J_c$ limit regardless of the details of the pinning mechanisms. In con-
trast, the different types of pinning centers (either naturally occurring or artificially
introduced by material nanoengineering) produce distinctively different $J_c$ behavior
as a function of $H$ strength and orientation. I will present a comparison of pin-
ning mechanisms in YBa$_2$Cu$_3$O$_7$ films and will analyze the possibilities of further
improvements.

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