Thickness dependence of critical current density in thick MgB_2 films

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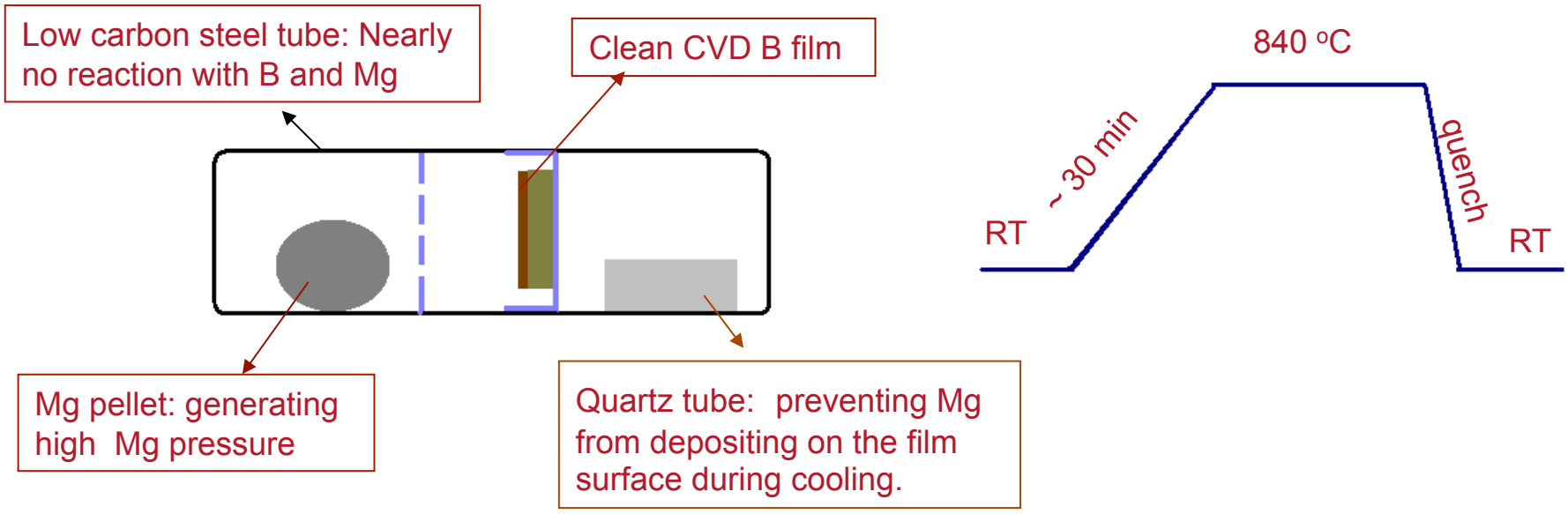
Ex Situ High Temperature Annealing CVD-Grown B Films in Mg Vapor

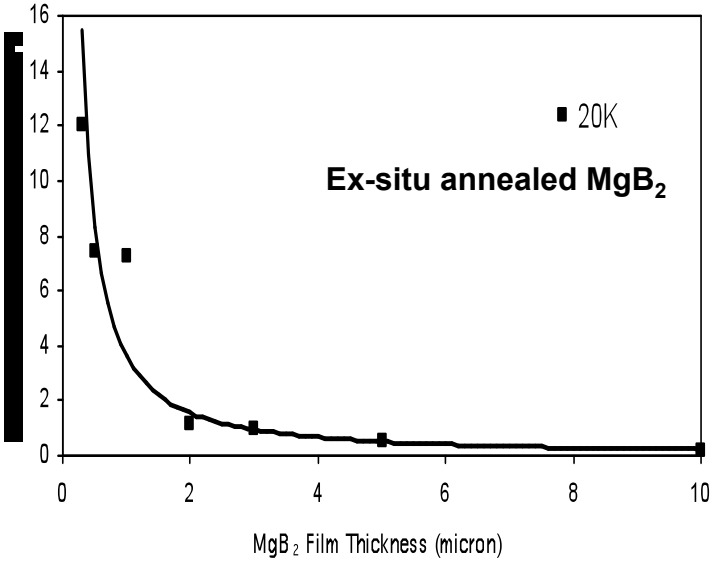


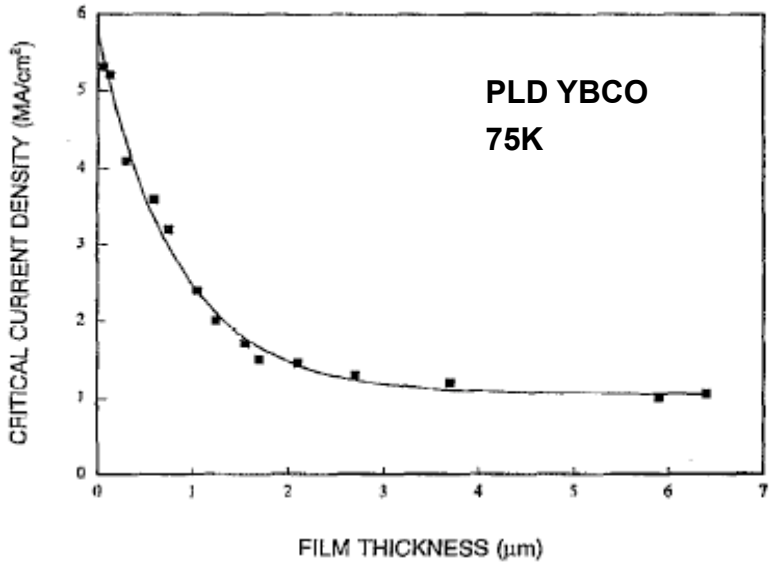
Results of MgB_2 Films Fabricated for Thickness Dependence Study (*Ex Situ* Annealed at 840°C)

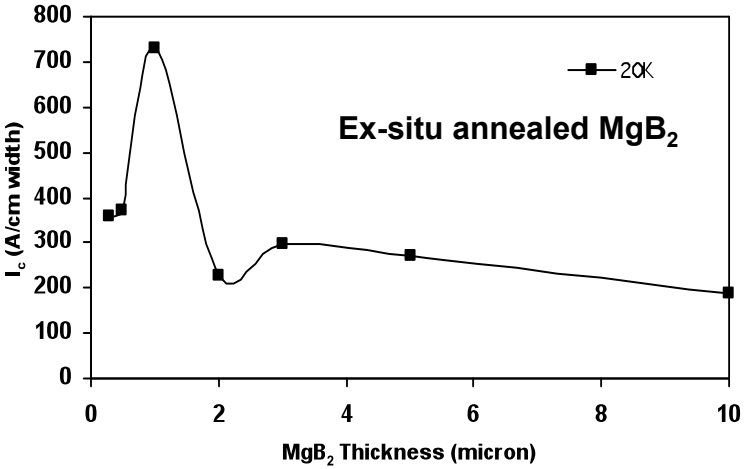
MgB_2 film thickness (μm)	**J_c (A/cm²) @ 0T,5K**	**J_c (A/cm²) @ 0T,20K**	**I_c (A/cm-w) @ 0T,5K**	**I_c (A/cm-w) @ 0T,20K**
0.3	1.97×10^7	1.2×10^7	591	360
0.5	1.41×10^7	7.42×10^6	705	371
1	1.36×10^7	7.28×10^6	1360	728
2	2.1×10^6	1.14×10^6	420	228
3	1.79×10^6	9.94×10^5	537	298
5	1.03×10^6	5.41×10^5	515	270
10	3×10^5	1.9×10^5	387	190

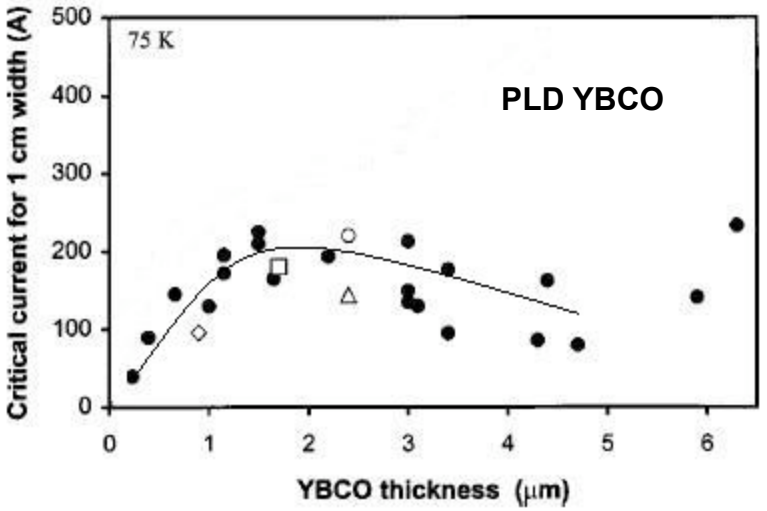
Hanna *et al*, Accepted for publishing in SC Sci. Tech.

J_c and I_c Thickness Dependence (MgB_2 versus YBCO)

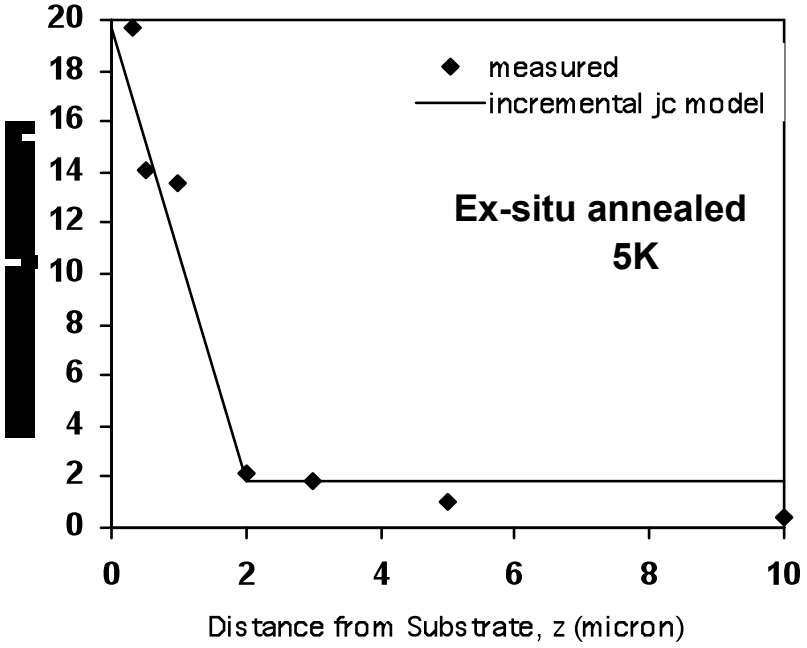








Incremental J_c Model (MgB2 vs. YBCO)



MgB2

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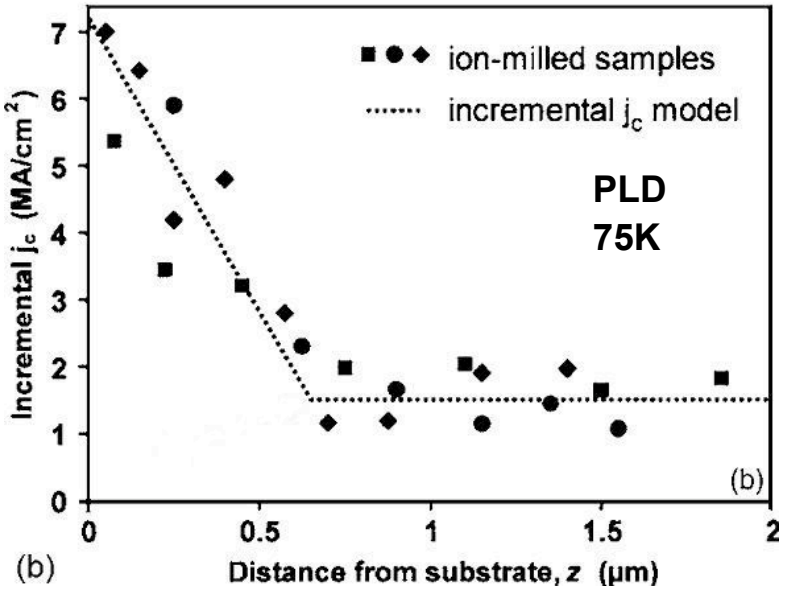

YBCO

Foltyn *et al*, 2005 Appl. Phys. Lett. 87 162505

Possible Explanations for J_c and I_c Drop with Increasing Thickness

- High density of flux pinning defects and dislocations near the film-substrate interface
- Vortices: as thickness *t* is increased, the Lorentz force, which is proportional to *t*, can only stay in balance with pinning forces by reducing J_c
- Microstructural degradation (cracks, porosity)
- Impurity diffusion during annealing

Thank You