

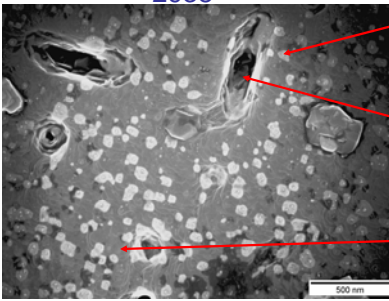
Exploring the Effects of Elixir (CeO_2) on the Properties of YBCO Thin Film Superconductors

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SEM pictures taken at 50,000X:

2938

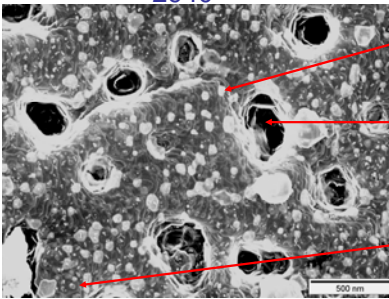


The elixir particles were deposited on the surface of this sample, after 150 nm of YBCO, and so they are fully exposed.

The holes in the YBCO layers are relatively large thus reducing the amount of current that can flow through the sample. This will cause the critical current density to be lower.

This sample shows relatively few surface detail peaks, and these few are not sharply defined.

2940

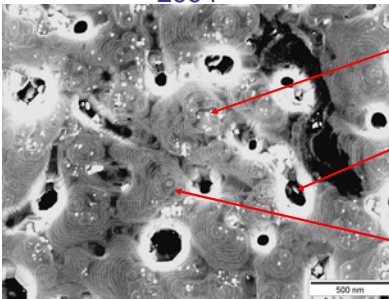


The elixir particles were deposited as the final layer after 200 nm of YBCO, and so they are fully exposed.

These holes in the YBCO are also relatively large thus reducing the amount of current that can flow through the sample. Again, this will cause the critical current density to be reduced.

This sample also shows relatively few surface detail peaks, but they are more clearly defined than the previous sample.

2994



The elixir particles were deposited on top of 150 nm and below the final 100 nm of YBCO. Therefore, only a few small parts of them are exposed.

The holes here are relatively small and will not reduce the amount of current that can flow through the sample significantly. So, the critical current density will not be significantly reduced.

This sample shows several very sharply defined surface detail peaks.

Introduction:

By adding an elixir of CeO_2 to a YBCO superconductor while it is being made, favorable results can be achieved. Unfortunately, it is not known exactly when this elixir should be added to produce the best possible sample, one with not only a high critical temperature but also a high critical current density. Through various methods the answer to this issue may be found. This research involved trying to find visual clues that could provide an explanation for some of the test data that had been taken from select YBCO samples.

Experiment process:

- Eleven samples were chosen for detailed study
- Each of these samples were then examined using two separate SEMs, one for high magnification pictures and the other for low magnification ones
- These pictures were carefully examined, and significant features and differences were noted
- Possible correlations with the test data were then made

Summarized test data:

ID Number	Layers	ΔT_c	T_c	Temp. Range
2984	5L	1.1	90.9	89.5 - 90.6
2994	3L+E+2L	0.6	90.7	89.7 - 90.3
3006	5L+E	1.1	90.2	88.8 - 89.9
2961	4L	2	90.5	88.0 - 90.0
2940	4L+E	1	90.1	88.8 - 89.8
2919	3L	1.1	90.2	88.8 - 89.9
2938	3L+E	1	90	88.8 - 89.8
2887	2L	1.3	90.5	88.8 - 90.1
2935	2L+E	1	90.4	89.1 - 90.1
2879	1L	10	86	70.0 - 80.0
2894	1L+E	1.8	85.8	83.5 - 85.3

In the above table, you can see that the optimum place to add the elixir is after 150 nm, or three layers, of YBCO. However, it is also important that elixir is not fully exposed on the surface as can be seen from the lower values and larger spreads of the critical temperatures of several of these samples in which the elixir was added after the final layer of YBCO.

Conclusion:

It appears that that adding the elixir after 150 nm of YBCO and then continuing to add 100 nm of YBCO produced the sample with the best properties. The observations of the visible surface details seem to support this claim which was based off of the test data. The sample that had the best test data also had the best SEM results. It had very well defined surface detail peaks and the smallest sized holes in the YBCO. Future work could include testing samples which are more than 250 nm thick, and also directly testing the critical current density of these samples. In addition, the behavior of these samples under the influence of a magnetic field would also be useful.

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