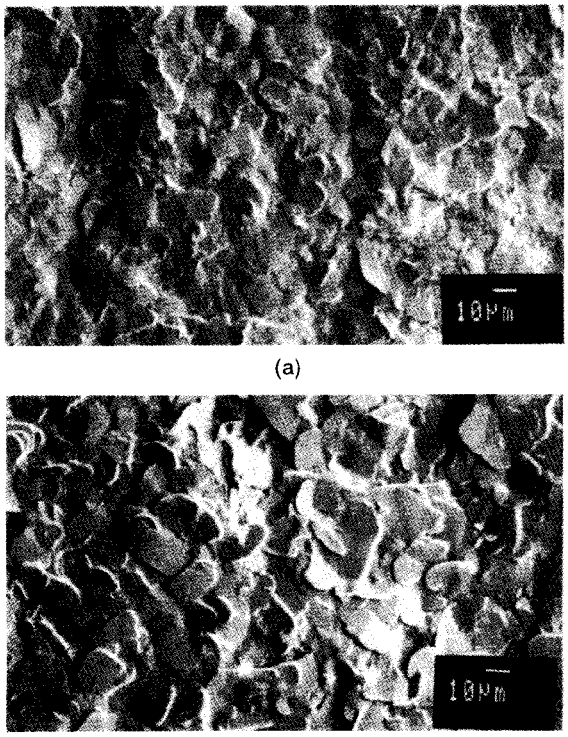

Figure 12. SEM micrograph of etched surfaces of powder 2 PIT tapes treated for a total of 100 h with (a) fast cooling and (b) slow cooling performed in all the sintering steps.

characteristics. For powder with high excess of Cu, the Bi-2223 formation rate is observed to increase initially. As reaction proceeds, however, the difference in Bi-2223 content amongst the three precursors is reduced and the %Bi-2223 is virtually indistinguishable after 60 h of processing. In addition, an optimum heat treatment schedule determined for the base powder in a previous study is found to remain valid even for precursors containing excess Cu. However, since any J_c enhancement in fully processed tapes made from excess Cu precursors is not substantial, it is not advisable to add a high amount of Cu which can result in secondary phases. In the present study, powder 2 is the best compromise in having a fast reaction rate while not affecting the secondary-phase content significantly.

Beneficial effects of slow cooling have been confirmed in PIT tapes made with powders 2 and 3. It is found that in all the heat treatment sequences examined in this study, the incorporation of one or more slow-cooling steps is effective in improving the J_c by a factor of two to four. The optimum treatments determined using results from a previous fast-cooling study can be utilized for the slow-cooling processes. However, modifications have to be made to compensate for the faster reaction kinetics of precursors with excess Cu. While both the 25–25–50 and 12–12–26–50 schedules performed equally well in samples containing precursor with no Cu addition and subjected to fast cooling only, the latter schedule appears to be better suited for the faster kinetics of precursors with Cu additions. Because of the increased reaction rate, highest J_c was obtained after 50 h of sintering time and slow cooling during the final step. If slow cooling is performed in every sintering interval, J_c reaches a maximum value after 50 h of accumulated sintering and starts to decrease due to insufficient amount of liquid phase to heal the processing cracks.

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