Quantitative texture analysis of single crystals/powder composite $Ca_3Co_4O_9$ bulk materials

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The $Ca_3Co_4O_9$ (Co-349) phase interests many researchers due to its relatively good thermoelectric performance and resistance to moisture and humidity. However, to consider the introduction of this material in power generation, the performances have to be improved. One of the ways for the enhancement of transport properties consists of the alignment of plate-like grains in the bulk materials. Indeed, the transport properties of Co-349 are highly anisotropic due to its structural lattice composed of CoO_2 and Ca_2CoO_3 layers and the resulting electrical resistivity in ab-planes (ρ_{ab}) is lower than in the c-direction. This strong anisotropy suggests that a texturation is necessary to optimise the bulk macroscopic properties. Moreover, the introduction of single crystals (SC) in the bulk powder materials prior to uniaxially press the composite is expected to reduce the macroscopic ρ_{ab} by decreasing the grain boundary influence. Based on the quantification of texture analysis, appropriate X-ray diffraction technique has been performed to characterize three samples prepared by hot-pressing and composed of 0-20%wt of SC. The incorporation of SC indeed decreases macroscopic ρ_{ab} (Fig. 1) of the samples. It proves that the SC in the composites act as bypasses for the current and reduce the influence of the grain boundaries. But, the most interesting point is the improvement of grain alignment with an increasing ~~the~~ amount of SC. The texture strengths of both Co349-matrix and Co349-SC have been quantified and revealed that the strong texture of SC helps the matrix texture development (Fig. 2).

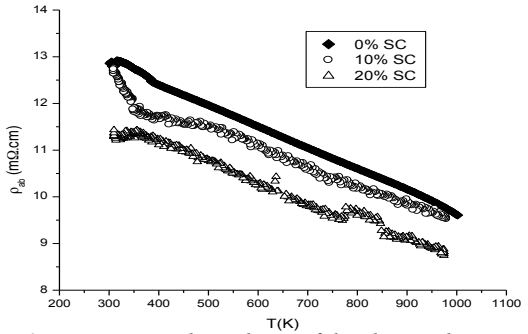

Fig.1 :Temperature dependence of the electrical resistivy for various amounts of SC.

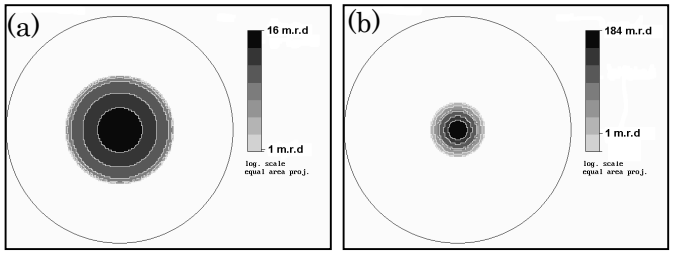

Fig.2 : Pole figures related to (a) Co-349-matrix phase and (b) Co-349 SC phase.