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Holes and vacancies across interfaces in superconducting Sr_2CuO_4-La_2CuO_4[1] S. SMADICI, J. LEE, P. ABBAMONTE, University of Illinois at Urbana-Champaign, IL 61801, G. LOGVENOV, I. BOZOVIC, Brookhaven National Laboratory, Upton, NY 11973 — Sr_2CuO_4 films with superconducting critical temperatures T_c up to 90 K have a substantial number of apical oxygen vacancies. An increase in T_c has been correlated in La_2CuO_4-$La_{2-x}Sr_xCuO_4$ bilayers with an increase in the apical oxygen – Cu atom distance. This suggests that the apical oxygen in these structures is not an entirely passive participant in high-T_c superconductivity. We studied Sr_2CuO_4-La_2CuO_4 superlattices with resonant soft x-ray scattering in order to quantify the apical oxygen scattering. At the O K edge we observed scattering resonances from mobile holes and apical oxygen vacancies. The apical vacancy resonant scattering factor was obtained. The distribution of apical vacancies measured at O K edge follows closely the structural imperfections measured with hard x-rays with a characteristic length 5.25 $\pm$ 0.75 A. The mobile holes diffuse with a characteristic length of λ=5.3 $\pm$ 1 A.

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