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Report:

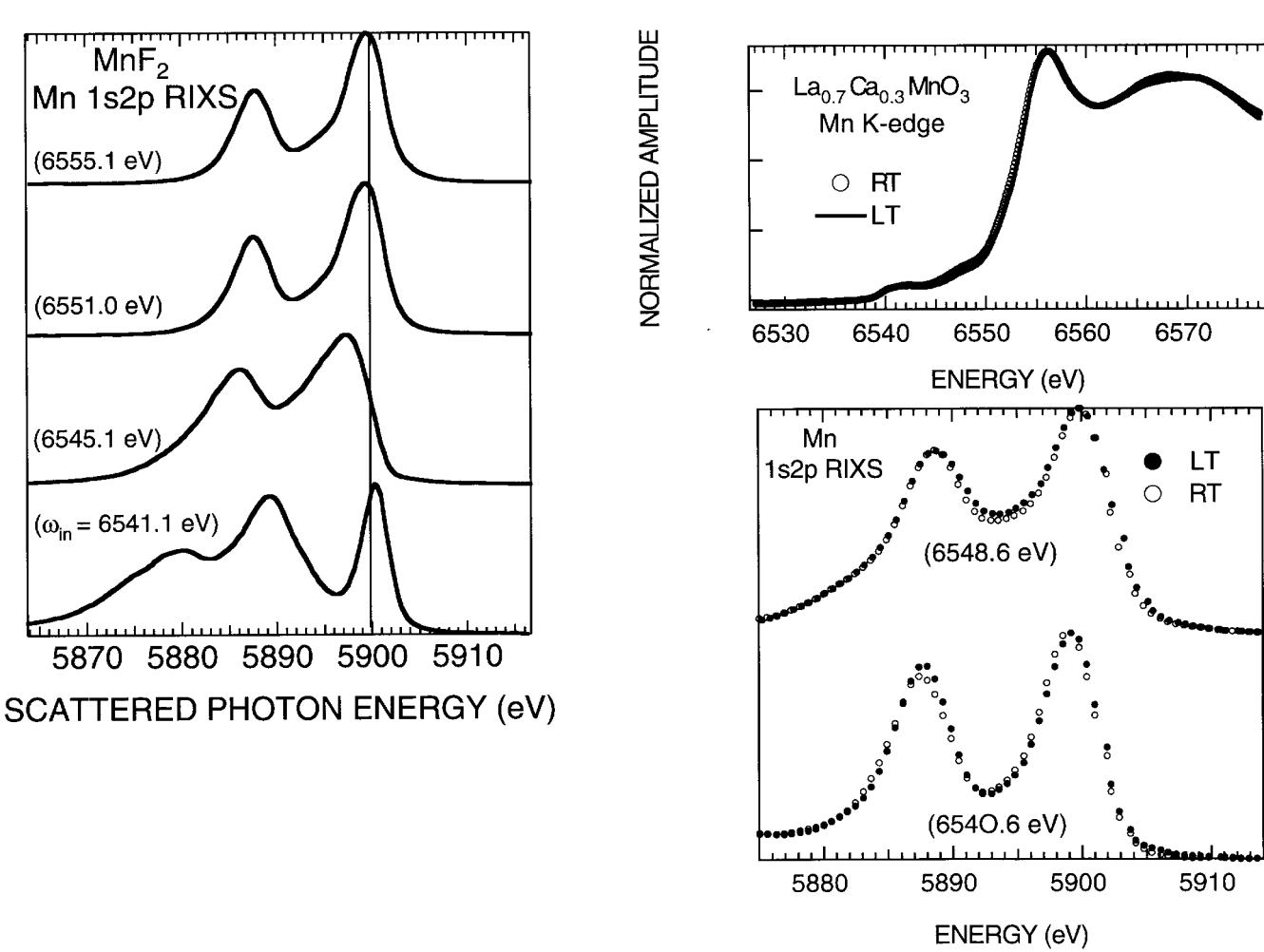
Spectroscopic techniques have been at the forefront in helping interpret the origin of the complex behavior of perovskite-type manganites in recent years. In particular, x-ray absorption near-edge-spectroscopy (XANES) has been used to examine the temperature dependence of the $\text{La}_{1-x}\text{Ca}_x\text{MnO}_3$ mixed valent system [1], while resonant x-ray scattering (RXS) measurements have provided direct evidence for charge and orbital ordering associated with alternate Mn^{3+} and Mn^{4+} arrays [2].

To date, resonant inelastic x-ray scattering (RIXS) measurements have largely concentrated on the $\text{K}\beta$ ($3\text{p}-1\text{s}$) spectrum in anti-ferromagnetic compounds such as MnF_2 (Ref. 3 and references there in) and the normal $\text{K}\beta$ x-ray fluorescence has also been studied in the case of some perovskites [4,5].

Here we have used the $1\text{s}2\text{p}$ RIXS ($1\text{s} \rightarrow 3\text{d}4\text{p} \rightarrow 2\text{p}$) as a means of identifying localized states in the manganites. $\text{Mn K}\alpha$ ($2\text{p} \rightarrow 1\text{s}$) represents about 80% of the total fluorescence intensity following a 1s core-hole ionization. It means that satisfactory signal strengths are encountered despite strong absorption effects due to the presence of a heavy element (in the case discussed here the La L-edge lies in the vicinity of the $\text{Mn K}\alpha$ line). Localized states are associated with dispersive structure in the scattered photon spectrum as a function of incident photon energy

Starting off with divalent MnF_2 we observe a clear dispersive behavior for the $1s\text{-}3d4p\text{-}2p$ RIXS in the pre-edge region. No such behavior is observed for LaMnO_3 . In this case the scattered x-ray energy remains constant down to ~ 15 eV below the white line. This implies that it is possible to access delocalized 4p-like states well below the white line and it substantiates a model proposed by de Groot [see Ref. 6] for iron oxides. A similar behavior is observed for CaMnO_3 except that this time dispersive structure is observed at excitation energies ~ 7 eV below the absorption maximum. Such structure is again observed in $\text{La}_{0.7}\text{Ca}_{0.3}\text{MnO}_3$. We conclude that our RIXS experiments highlight the localization of e_g states for $x=0.3$ in $\text{La}_{1-x}\text{Ca}_x\text{MnO}_3$.

The XANES measurements we performed on our $\text{La}_{0.7}\text{Ca}_{0.3}\text{MnO}_3$ sample confirmed the temperature dependence reported elsewhere and preliminary RIXS experiments as a function of temperature were also attempted. Further work is required to quantify the temperature dependence of the RIXS data so as to eliminate small variations in intensity due to geometrical changes in the set up at very low temperatures. We consider these experiments to be encouraging. Minor instrumental improvements are under way to ensure the extraction of quantitative information from future experiments.



References

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