Possible Topological Insulating State in $Bi_{1-x}As_x$: Magneto-optical study

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Introduction

Bismuth and its alloys with antimony have attracted attention in recent years due to possible realization of topological insulating state [1]. In this study we have used infrared and magneto-optical spectroscopies to probe the electrodynamic response of bismuth doped with 1.0 % of arsenic ($Bi_{1-x}As_x$).

Experimental

Samples of $Bi_{1-x}As_x$ for this study were grown at the Serbian Academy of Sciences and Arts. The magneto-reflectance measurements were performed at the NHMFL with a Fourier Transform Infrared (FT-IR) spectrometer Bruker 113, coupled to a 18 Tesla superconducting magnet.. All the measurements were performed at temperature 4.2 K. The focus of the study was on the far-infrared frequency range, approximately from 30 cm^{-1} to 600 cm^{-1}.

Results and Discussion

Magneto-reflectance ratios R(ω,B)/R(ω, 0 Tesla) are shown in **Figure 1** for $Bi_{1-x}As_x$ at several characteristic magnetic fields between 0 and 18 Tesla. Large magnetic field induced changes (as large as 22 %) are observed around and below the plasma minimum in reflectance, which is located at around 250 cm^{-1}).

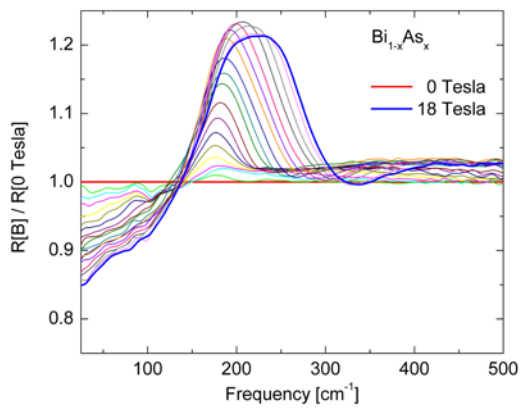

Figure 1. *Magneto-reflectance ratios R[B]/R[0 Tesla] for $Bi_{1-x}As_x$ at magnetic fields between 0 and 18 Tesla.*

Conclusions

Our measurements of $Bi_{1-x}As_x$ have revealed extreme sensitivity of optical properties to external magnetic field. These results are to be compared and contrasted with similar measurements we have done on topological insulator $Bi_{1-x}Sb_x$ [2]. Understanding these magneto-optical results might be an important step toward elucidating complex electronic structure of topological insulators.

Acknowledgements

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References

[1] Hasan, M.Z., *et al*., Rev. Mod. Phys. **82**, 3045 (2010).
[2] Dordevic, S.V., *et al*., Phys. Rev. B **86**, 115119 (2012).