MANIPULATION OF THE OPTICAL PROPERTIES OF MANGANESE PHTHALOCYANINE THIN FILMS INDUCED BY POTASSIUM DOPING

M. Ludemann\textsuperscript{a}, F. Haidu\textsuperscript{a}, P. Schäfer\textsuperscript{a}, B. Mahns\textsuperscript{b}, D. Lehmann\textsuperscript{a}, O. D. Gordan\textsuperscript{a}, J. Kortus\textsuperscript{c}, M. Knupfer\textsuperscript{b}, and D. R. T. Zahn\textsuperscript{a}

\textsuperscript{a}Semiconductor Physics, Chemnitz University of Technology, D-09107 Chemnitz, Germany
\textsuperscript{b}Electronic and Optical Properties, Helmholtzstr. 20, D-01069 Dresden, Institute for Solid State Research, Germany
\textsuperscript{c}Theoretical Physics, TU Bergakademie Freiberg, Leipziger Str. 23, D-09599 Freiberg, Germany

Not only the electrical \cite{1} and the magnetic \cite{2} properties of metal phthalocyanines (MePcs) can be manipulated by alkali doping. \textit{In situ} spectroscopic ellipsometry during potassium doping of manganese phthalocyanine reveals that also the optical properties markedly change, especially in the visible spectral range. \textit{In situ} online monitoring of the vibrational properties via Raman spectroscopy provides deep insight into the doping dynamics. The formation of three consecutive doped phases with integer stoichiometry is observed, e.g. K\textsubscript{1}[MnPc], K\textsubscript{2}[MnPc], and K\textsubscript{4}[MnPc].

In this study, MnPc thin films (5–100 nm) are prepared by organic molecular beam deposition (OMBD) under ultra-high vacuum (UHV) conditions. Doping is achieved via subsequent potassium (K) evaporation. Among the group of transition MePcs, MnPc exhibits unique properties, e.g. optical absorption (states) energetically below the Q-band (1.2–2.2 eV) and the highest spin state of 3/2. Therefore, alkali doped MnPc is an interesting candidate for spintronic applications.

Despite the fact that Raman spectroscopy provides an abundance of information, e.g. about chemical reaction dynamics, composition, charge transfer, and crystallinity, Raman investigations on doped organic semiconductors are still rare. This work demonstrates that Raman spectroscopy is a powerful experimental tool to observe phase transition processes in a non-invasive way.

Keywords: \textit{in situ} Raman spectroscopy, \textit{in situ} spectroscopic ellipsometry, alkali metal doping

References