

New photon upconversion processes in transition metal and lanthanide metal doped materials

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Lanthanide doped oxides and fluorides are established upconversion phosphors and laser materials. We are exploring near-IR to visible upconversion (UC) processes in Ti^{2+} , Ni^{2+} , Mo^{3+} , Re^{4+} and Os^{4+} doped halides. We observe energy-transfer UC processes as well as sequences of ground and excited state absorption steps [1]. Excitation avalanches occur in some of the Os^{4+} doped systems. Magnetic Mn^{2+} host lattices can lead to an exchange enhancement of the UC efficiencies in Ni^{2+} doped crystals by orders of magnitude. The UC processes in the Mo^{3+} and Re^{4+} doped systems are very efficiently sensitised by Yb^{3+} . Completely new and unexpected UC processes can be induced in Yb^{3+} doped Mn^{2+} and Cr^{3+} compounds [2, 3]. Excitation of the $^2\text{F}_{5/2}$ levels of Yb^{3+} around $1\mu\text{m}$ is the first step. A second step, either by excited state absorption or energy transfer, directly leads to Mn^{2+} and Cr^{3+} excitation, with subsequent $^4\text{T}_1$ and ^2E emission in the visible, respectively. Exchange interactions between Yb^{3+} and Mn^{2+} or Cr^{3+} play a crucial role in this new upconversion process.

References:

- [1] Daniel R. Gamelin and Hans U. Güdel
Upconversion Processes in Transition Metal and Rare Earth Metal Systems,
in "Transition Metal and Rare Earth Compounds. - Excited States, Transitions, Interactions II",
Ed. Hartmut Yersin
Topics in Current Chemistry 214, 1-56 (2001)
- [2] Rafael Valiente, Oliver Wenger and Hans U. Güdel
New photon upconversion processes in Yb^{3+} doped CsMnCl_3 and RbMnCl_3
Chem. Phys. Lett. 320, 639-644 (2000)
- [3] S. Heer, M. Wermuth, K. Krämer and H. U. Güdel
Upconversion Excitation of Cr^{3+} ^2E Emission in $\text{Y}_3\text{Ga}_5\text{O}_{12}$ Codoped with Cr^{3+} and Yb^{3+}
Chem. Phys. Lett. 334, 293-297 (2001)