Yttrium aluminum garnet (Cr^{4+}:YAG) with tetrahedrally coordinated Cr^{4+} ions has attracted a great deal of attention because of its potential application as a component of tunable solid-state lasers in the 1.35-1.55 μm spectral range or passive Q-switches for laser systems based on YAG doped with rare-earth ions such as Nd^{3+} and Yb^{3+}. However, the lasing efficiency of a high-quality Cr^{4+}:YAG crystals is no higher than 10% indicating the fact that another energy loss process of unknown origin is active in these crystals. We anticipate that one of the possible reason for energy loss in Cr^{4+}:YAG materials is an anti-Stokes white emission caused by excited state absorption on Cr^{4+} ions which results in further energy transfer upconversions. It is worth highlighting that anti-Stokes white emission in Cr^{4+}:YAG is the result from energy lose in Cr^{4+} ions. Therefore, studying it will allow us to better understand the energy loss nature in Cr^{4+}:YAG laser materials. To the best of our knowledge, there is no report on the anti-Stokes white emission involving Cr^{4+}:YAG materials in the existing literature. Thus, understanding the nature of this process will certainly pave the way to reduce the negative effects on laser performance of Cr^{4+}:YAG materials.

The exciting feature of Cr^{4+} ions in YAG matrix involves the possibility to occupy two crystallographic positions: octahedral and tetrahedral sites while the later ions are responsible for laser properties. Originally Cr incorporates into YAG in trivalent state, whereas, the formation of Cr^{4+} ions requires using divalent impurities (Ca^{2+} or Mg^{2+}) as a charge compensator of Cr^{4+} ions. Only a few percent of divalent impurities are compensated by Cr^{4+} while the rest stabilize by oxygen vacancy. Therefore, it predicts the energy transfer from tetrahedral Cr^{4+} to octahedral Cr^{4+} ions or/and to lattice defects which stabilize divalent impurities. Moreover, Cr,Yb:YAG materials are quite popular as self Q-switched lasers where Yb^{3+} and Cr^{4+} ions are simultaneously doped into the YAG matrix. It is expected that different kinds of dopants and their concentrations will have influence on the efficiency of anti-Stokes white emission and on laser performance of Cr^{4+}:YAG laser materials.

The first step of the project will be a making of Cr,Yb:YAG nanoceramics in concentration function. The samples will be synthesized by modified Pechini method. To ensure that no energy migration to impurities is responsible for the observed broadband anti-Stokes white emissions the high purity initial compounds will be used for synthesis. The phase homogeneously and purity of synthesized sample will be examined by means of powder X-ray diffraction, ICP measurement, and Raman spectroscopy. The particles size and morphology will be investigated by Transmission Electron and Scanning Electron Microscopies.

After structural and morphology characterization of compound will be performed an optical measurement: influence of power excitation on emission intensity, influence of pressure condition on the emission intensity, rise end decay time of luminescence. We will measure also a quantum yield of Anti-Stokes broadband emission in integration sphere and photoconductivity of compounds. The luminance and CIE coordinates will be determined. The temperature of the samples during the anti-Stokes broadband white emissions will be determined by means of nanothermometry method.

Analysis of these results together with an analysis of available in the literature data on the location of the energy levels of Cr^{4+} ions will propose a model describing the generation of white emission in Cr^{4+}:YAG laser materials.