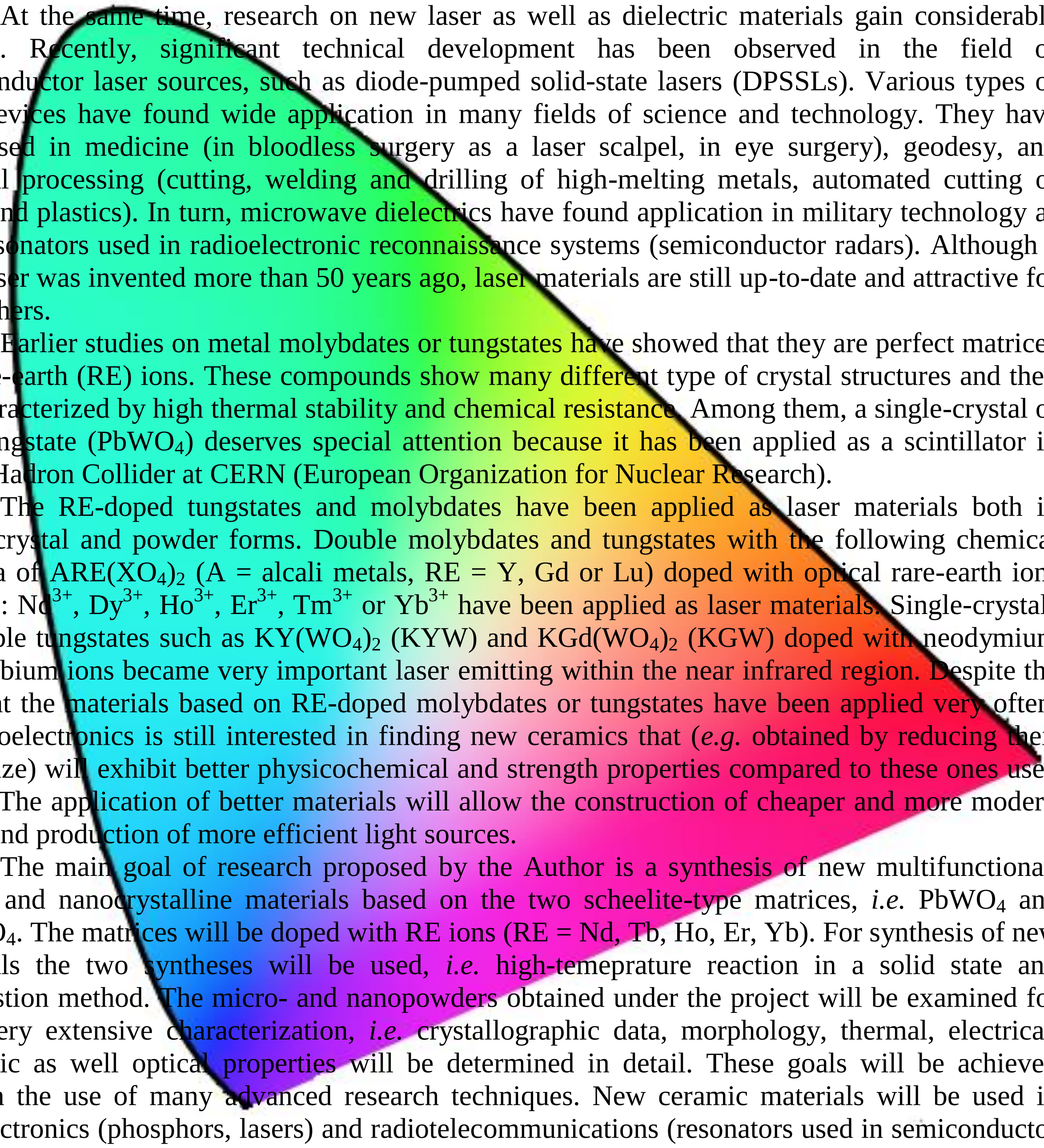
New micro- and nanocrystalline phosphor materials and microwave dielectrics based on some scheelite-type matrices

For many years, studies have been conducted on advanced optical materials such as phosphors and scintillators. Increasingly expensive electricity and new legal conditions require an application of more efficient light sources. Thus, scientists are interested in materials that can be used in energy-efficient lighting. In addition to economic considerations, such features of modern light sources as: a long service life, small sizes and low heat emission play a significant role. Therefore, environmentally friendly and economical solutions are constantly sought after.



At the same time, research on new laser as well as dielectric materials gain considerable interest. Recently, significant technical development has been observed in the field of semiconductor laser sources, such as diode-pumped solid-state lasers (DPSSLs). Various types of laser devices have found wide application in many fields of science and technology. They have been used in medicine (in bloodless surgery as a laser scalpel, in eye surgery), geodesy, and material processing (cutting, welding and drilling of high-melting metals, automated cutting of paper and plastics). In turn, microwave dielectrics have found application in military technology as new resonators used in radioelectronic reconnaissance systems (semiconductor radars). Although a ruby laser was invented more than 50 years ago, laser materials are still up-to-date and attractive for researchers.

Earlier studies on metal molybdates or tungstates have showed that they are perfect matrices for rare-earth (RE) ions. These compounds show many different type of crystal structures and they are characterized by high thermal stability and chemical resistance. Among them, a single-crystal of lead tungstate ($PbWO_4$) deserves special attention because it has been applied as a scintillator in Large Hadron Collider at CERN (European Organization for Nuclear Research).

The RE-doped tungstates and molybdates have been applied as laser materials both in single-crystal and powder forms. Double molybdates and tungstates with the following chemical formula of $ARE(XO_4)_2$ (A = alcali metals, RE = Y, Gd or Lu) doped with optical rare-earth ions such as: Nd^{3+}, Dy^{3+}, Ho^{3+}, Er^{3+}, Tm^{3+} or Yb^{3+} have been applied as laser materials. Single-crystals of double tungstates such as $KY(WO_4)_2$ (KYW) and $KGd(WO_4)_2$ (KGW) doped with neodymium or ytterbium ions became very important laser emitting within the near infrared region. Despite the fact that the materials based on RE-doped molybdates or tungstates have been applied very often, the optoelectronics is still interested in finding new ceramics that (*e.g.* obtained by reducing their grain size) will exhibit better physicochemical and strength properties compared to these ones used so far. The application of better materials will allow the construction of cheaper and more modern lasers and production of more efficient light sources.

The main goal of research proposed by the Author is a synthesis of new multifunctional, micro- and nanocrystalline materials based on the two scheelite-type matrices, *i.e.* $PbWO_4$ and $PbMoO_4$. The matrices will be doped with RE ions (RE = Nd, Tb, Ho, Er, Yb). For synthesis of new materials the two syntheses will be used, *i.e.* high-temeprature reaction in a solid state and combustion method. The micro- and nanopowders obtained under the project will be examined for their very extensive characterization, *i.e.* crystallographic data, morphology, thermal, electrical, magnetic as well optical properties will be determined in detail. These goals will be achieved through the use of many advanced research techniques. New ceramic materials will be used in optoelectronics (phosphors, lasers) and radiotelecommunications (resonators used in semiconductor radars). The subject of the research proposed within the project proves to be valid and at the same time constitutes an important scientific novelty.