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Report on the Habilitation thesis of Dr Martin Nikl

To whom it may concern

Dr. Martin Nikl presents in his habilitation thesis the general strategy and highlights of his research activity on modern fast scintillating materials based on the doped complex oxydes. The presented work starts with a general presentation of scintillators as well as scintillation mechanisms, but also the growth processes. The deep connection between material preparation and scintillating performances is clearly emphasized in this material science oriented work. A deep focus on 3 families: garnet, perovskite and silicate oxides. The key role of defects inducing traps is described in details. Such traps induce slow components in the time response under ionizing radiation rendering "artificially" the time resolved light yield smaller than expected in many compounds. It is clearly demonstrated by the comparison of performances under continuous x-ray excitation and the light yield measured with pulse height spectra, which uses a time gate of integration. This demonstrates that the whole potential of the number of relaxed electron-hole pairs is not directly transferred to the activator and that significant losses due to the traps reduce the crystal performances. Based on this consideration, Dr. Nikl leaded, in cooperation with several international groups, an activity aiming to drastically improve the crystal quality following 3 successful strategies. The first one is related to the adequate introduction of co-dopant in the already activated materials. These co-doping play the role of charge and space compensator. Optimization of their concentration reduces the number of traps and a significant fraction of the slow component is converted in the fast one. The second one consists to select mixed composition to limit the effect of the distribution coefficient, rendering the doping more favorable. The last, and probably the most impressive work is on the gap engineering. Indeed, instead of removing traps, which is sometime hardly controllable in material chemistry, this strategy is to render them inefficient i.e. being hardly able to trap charges. Changing the composition of a crystal acts thus on the relative position, in the energy band and level diagram, between the bottom of the conduction band and the trap level. When the trap level is located inside the conduction band, the trap does not act anymore and the crystal behaves more or less as free of traps.

These nice and innovative results enabled to offer a "new" life to cerium and praseodymium doped garnets as well as to the lutetium and gadolinium based silicates. These crystals are now considered as serious candidates for high energy physics and in PET application. Some of these compositions present good stability of their performances when temperature is increased to high temperature, rendering them attractive for oil drilling search.

Apart of these scientific results, the outstanding research records of Dr Martin Nikl demonstrates a clear and real international recognition (h-index 47, many invited talks in international conferences). By the way, he has been invited to write review papers, which are well cited. As another proof of this recognition, he is involved in the advisory boards of most of the International Conference dealing with Scintillation, Luminescence or defects in Solids. He is also involved in several EU projects such as COST and ITN.

Based on these considerations, as Professor of the University Lyon1 but also as the Chairman of the Advisory Committee of the SCINT conference, the most important international conference on Inorganic Scintillators, I fully support and recommend without any doubts to continue the habilitation procedure and to award Dr. Martin Nikl by the title Assistant Professor.

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