Task Specification (TS)

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Task Title:	**Contribution to the project ENR-MAT.02.KIPT**		
IMS Reference:	**ENR-MAT.02.KIPT-T001**	Task coordinator:	**Sergii Ubizskii**
Status:	**Accepted**	Duration:	01.01.2024 .000 -- 31.12.2024 .000

Technical Specification:

WP1. Powders fabrication and study of their structural and morphological properties

- 1.1. Synthesis of partially and completely substituted compositions based on Mg1–xAxAl2O4, where A is Zn, Ca, Sr, Ba using different methods (sol-gel and solution combustion) to obtain a single phase monodisperse powder with small particle size;
- 1.2. Establishing of solubility of substituting cations and a boundary for cubic phase existence in spinel structure, refinement of phase diagram and detailed crystal structure parameters;
  1.3. Investigation of the influence of synthesis regimes on size, size distribution and particle morphology of synthesized nano-powders;
- 1.4. Comparison studies of different methods of powder synthesis from the point of view of requirements for dense optical ceramics fabrication and choosing the most prospective compositions for this purpose.
- 1.5. Fabrication of precursors of selected compositions for transparent ceramics obtaining.

WP2. Theoretical study of new spinel compounds by computational methods

- 2.1. Ab-initio modelling of the crystalline and electronic structure of the new cubic spinel compositions and establishing an influence of the substitution degree on the band gap of spinels;
- 2.2. Modelling of mutability of the crystalline/electronic structure of substituted spinels on the inversion degree;
- 2.3. Simulation study of radiation defects formation and transformation, the influence of the inversion degree on defects' formation and annihilation;
- 2.4. Analysis and comparison of theoretical results with experimental data.

WP3. Sintering and structural properties of high transparent spinel ceramics

- 3.1. Parametric study of the ceramics sintering process for new spinel precursors;
- 3.2. Structural analysis of obtained ceramics on the atomic, micro- and macro-scale levels;
- 3.3. Investigation of the relation between chemical composition and transparent ceramic sintering regimes;
- 3.4. Investigation of the interrelation of precursors' sintering method, morphology and size distribution and ceramic structure perfectness and optical transparency;
- 3.5. Comprehensive analysis of expected behaviour of optical ceramics under irradiation and choosing the most promising samples for irradiation study.

WP4. Radiation tolerance study of new spinel-structured ceramics for optical windows

- 4.1. Preparatory works and detailed characterization of pristine spinel structured powder samples as well as the irradiated those, which have to been selected, via a complex of spectroscopic methods;
- 4.2. Detailed characterization of the selected polycrystalline ceramics (including optical ones) before and after exposure to irradiation;
- 4.3. Comparative characterization of pristine/irradiated spinel-structured ceramics of different origin via a complex of spectroscopic methods, incl. synchrotron facilities;
- 4.4. Detailed analysis of the recovery of radiation damage via precise isothermal thermal annealing of the irradiated ceramics. Analysis/modelling of the annealing kinetics and estimation/prediction the radiation tolerance of novel materials in comparison with that for well-studied mineral spinel MgAl2O4.

Deliverables of the task ENR-MAT.02.KIPT-T001:

ID	Owner	Details
D001	**Sergii Ubizskii** Lead Beneficiary: **KIPT**	**Intermediate report** Description: At the end of the first year of the project, the first cycle of research on all planned compound systems should be conducted, the most promising compounds should be selected, precursorsshould be produced, and the first samples of transparent ceramics of new compounds should be made and defect studies should be started. The 1st year report will include these results and preprints of submitted papers and presentations.

The Team

Beneficiary	Year	Participant Name	Affiliated Entity (optional)	Commitment [PM]
CEA	2024	TBD (Open position(s)) (*)		
		Kanaev Andrei (*)		4.0
		Lemarchand Alex	01-CNRS	2.0
		Museur Luc	13-SORBONNE NORD	2.0
		Schoenstein Frédéric	13-SORBONNE NORD	4.0
		Trannoy Virgile	01-CNRS	4.0
		Traore Mamadou	01-CNRS	2.0
		Vrel Dominique	01-CNRS	2.0
			Subtotal	20.0
KIPT	2024	Buryy Oleh	02-LPNU	8.0
		Hreb Vasyl	02-LPNU	12.0
		Klym Halyna	02-LPNU	9.0
		Klysko Yurii	02-LPNU	10.0
		Lutsyuk Iryna	02-LPNU	7.0
		Poshyvak Oleksandr	02-LPNU	10.0
		Stadnik Vitalii	02-LPNU	12.0
		Syrotyuk Stepan (*)	02-LPNU	4.0
		Ubizskii Sergii	02-LPNU	11.0
		Vasylechko Leonid	02-LPNU	11.0
		Zhydachevskii Yaroslav	02-LPNU	10.0
			Subtotal	104.0
UT	2024	Feldbach Eduard		6.0
		Krasnenko Veera		7.0
		Krasnikov Aleksei		9.0
		Lushchik Aleksandr		6.0
		Romet Ivo		6.0
		Seeman Viktor		6.0
		Shablonin Jevgeni		6.0
			Subtotal	46.0
			PROJECT TOTAL	170.0

(*) Team members covered by other means than the project budget
(**) Team members covered by national funds through Accompanying Research programme

Allocated resources:

Financial summary per sub-category excluding contributions by EPFL and UKAEA,

Total Resources (per cost category) and Consortium Contribution in [k€].

ID	Title	Due Date	Beneficiary	AWP2024		
				Total Res. (Eq./OGS 40% standard)	Total Res. (PM 50% standard)	Cons. Contr.
D001	Intermediate report	31-Dec-24	CEA	12.500	163.333	86.667
			KIPT		150.000	75.000
			UT		164.833	82.417
			TOTAL:	12.500	478.167	244.083

Involvement of EPFL as associated partner to MPG, Total Resources (per cost category) in [k€].

ID	Title	Due Date	Associated parthner	AWP2024	
				Total Res. (Eq./OGS 40% standard)	Total Res. (PM 50% standard)
			TOTAL:	0.000	0.000

Involvement of UKAEA as associated partner to MPG, Total Resources (per cost category) in [k€].

ID	Title	Due Date	Associated parthner	AWP2024	
				Total Res. (Eq./OGS 40% standard)	Total Res. (PM 50% standard)
			TOTAL:	0.000	0.000

Acceptance criteria for this task:

- The task shall be carried out along the lines defined in the technical specification.
- Achieved Deliverable(s) to be reported and approved through EUROfusion IDM (https://idm.euro-fusion.org)
- *further criteria as required*