

1 Project

1.1 Acronym

NAPOLY (Nanocrystals in Polymers)

1.2 Description (1 sentence)

NAPOLY aims at establishing design rules for the homogeneous dispersion of nanoparticles in polymers by setting up a library of surface ligand/polymer matrix combinations that is inspired by two application cases: fast bonding/debonding-on-command of polymer-based adhesives and the formation of nanoparticle-in-resin composites with bespoke emission spectrum.

1.3 Project type (ICON, COOCK, O&O, cSBO,...)

cSBO

1.4 (approximate) Start date

April 1st, 2023

1.5 Project Duration

48 months

1.6 Channel (SIM program, intercluster, ...)

intercluster

2 Project partners

2.1 Knowledge institutes:

Organisation		Contact person	
Name	VAT Nr	name	Email address
Flanders Make	BE0860286268	Ahmed Elmahdy	Ahmed.Elmahdy@flandersmake.be
Ghent University	BE0248015142	Zeger Hens, Klaartje De Buysser, Filip Du Prez	zeger.hens@ugent.be
KU Leuven Research & Development	BE 0419.052.173	Youri Meuret	Youri.meuret@kuleuven.be

2.2 Industrial partners

Organisation		Contact person	
Name	VAT Nr	name	Email address

3 INNOVATION TARGET(s) (between a quarter and half an A4 page)

NAPOLY will address the challenges of setting up design rules for the formation of homogeneous nanocrystal-in-polymers composites by means of a dual approach that creates (i) fundamental scientific insights starting from (ii) specific requirements from two diverse, industrially-relevant use cases. These use cases involve (i) bondable/de-bondable polymer adhesives by incorporation of magnetic nanocrystals and (ii) emissive resins for luminescent color conversion by incorporation of quantum dots.

Five innovation targets have been defined within the NAPOLY CSBO:

1. **Design and advanced characterization of a library of polymer matrices and ligand combinations for homogeneous nanocrystal-in-polymer composites.** A library of model systems will be set up using (1) magnetic and (2) photoluminescent semiconductor nanocrystals as reference materials in combination with a selection of polymers with different properties (apolar, polar / thermal curing, photocuring / ...).
2. **Practical nanocrystal-in-polymer composites for use case development.** Here, the aim is to transfer the library/matrix combinations to develop homogeneous nanocrystal-in-polymer composites fully aligned with industrial interest and ready for use-case development.
3. **Patterned deposition of nanocrystal-in-polymer composites.** Using the example of emissive resins, methods for 2D/3D patterned deposition of nanocrystal-in-polymer composites at 1-1000 μm length scales will be developed, using inkjet printing of curable resins or direct structural illumination for 1 photon or 2 photon polymerization.
4. **Demonstrate fast bonding/debonding-on-command of polymer adhesives through addition of magnetic nanocrystals.** By means of selected practical magnetic nanocrystals-in-polymer composites, fast bonding/debonding-on-command through Joule heating fields will be tested through demonstrators developed according to user committee specifications.
5. **Demonstrate remote and on-chip color conversion by arrays of quantum-dot-in-resin structures.** By means of selected practical luminescent nanocrystals-in-polymer composites, different color-conversion structures for lighting, signage and display applications will be demonstrated according to user committee specifications.

4 Milestones

M1	Library of model systems established and implemented for first, proof-of-concept model demonstrations. (M24).
M2	Library of model systems translated into practical, industrially relevant compositions for use-case development (M24).
M3	Patterned deposition of nanocrystal-in-composites realized (M36).
M4	Proof-of-concept demonstrators (bonding/debonding; color conversion) by means of industrially relevant nanocrystal-in-polymer composites (M48).

5 Budget estimation

5.1 Knowledge institutes

Flanders Make	40 FTE months	Postdoc level
Ghent University	96 FTE months	PhD level
	84 FTE months	Postdoc level
University of Leuven	48 FTE months	PhD level