Step 2 Evaluation Report

CONFIDENTIAL

Call reference	ERC-2011-StG
Activity	ERC Starting Grant
Funding scheme	
Panel name	PE8 - Products and process engineering
Proposal No.	278004
Acronym	FreeCo
Panel decision on Career Stage	Starter
Applicant Name	Sylvain Deville
Title	Freezing Colloids

PANEL MARKS

1. Principal Investigator ***Intellectual capacity and creativity:*** *To what extent are the achievements and publications of the Principal Investigator groundbreaking and demonstrative of independent creative thinking and capacity to go significantly beyond the state of the art? To what extent will an ERC Starting Grant make a significant contribution to the establishment or consolidation of independence?* ***Commitment:*** *Is the Principal Investigator strongly committed to the project and willing to devote a significant amount of time to it (they will be expected to devote at least 50% of their working time to the ERC-funded project)?*	**4.0 / 4**
2. Research project ***Ground-breaking nature and potential impact of the research:*** *To what extent does the proposed research address important challenges at the frontiers of the field(s) addressed? To what extent does it have suitably ambitious objectives, which go substantially beyond the current state of the art (e.g. including inter- and trans-disciplinary developments and novel or unconventional concepts and/or approaches)?* ***Methodology:*** *To what extent does the possibility of a major breakthrough with an impact beyond a specific research domain/discipline justify any highly novel and/or unconventional methodologies ("high-gain/high-risk balance")? To what extent is the proposed research methodology (including the proposed timescales and resources) appropriate to achieve the goals of the project? To what extent are the resources requested necessary and properly justified? If it is proposed that team members engaged by another host institution participate in the project is their participation fully justified by the scientific added value they bring to the project?*	**4.0 / 4**
Total mark	**8.0 / 8**
Has the proposal passed the thresholds (2/4) for criteria 1 and 2?	**Yes**

PANEL COMMENT

This evaluation report contains the final recommendations and marks awarded by the ERC review panel during the second step of the ERC Starting Grant review. The panel based its appraisal on prior individual reviews conducted by panel members and external referees and on the interview with the applicant.

The panel closely examined all the individual review reports and, while not necessarily subscribing to each and every opinion expressed, found that they provide a fair overall assessment. The comments of the individual reviewers are included in this report.

The presentation given by the applicant during the interview and the answers to the questions that were addressed greatly contributed to build the panel's view about the proposal's strengths and weaknesses.

Both the individual reviews and the interview were the basis for the discussion and the final recommendation of the panel.

The panel recognised that, as highlighted by the reviewers, the candidate has an extremely strong background and track-record in the field of colloids and materials science. The panel agreed with the reviewers that the candidate has conducted creative and independent high quality work and that his top publications (in for example in Materials Nature, Science, Nanoletters, etc.) report ground-breaking work.

The panel agreed with the reviewers that this is an excellent proposal that aims to provide a deeper understanding of the processes involved with colloid freezing. This work is expected to lead to a better control of the materials produced.
During the presentation, the candidate described why he is interested in the field and generally how the processes behave. He explained that the project stages comprise: Observing; Modelling [at Oxford University]; Controlling; and Applying – the latter in porous composites. He concluded that the work is significantly beyond materials science.
In the question and answer session, the panel asked the candidate to comment on the role of pressure. He suggested that it was easier to control temperature and that it was one of the more important parameters in freezing. In response to a question on applications he said that this work was a fundamental study and the applications will come later. He confirmed that the modelling at Oxford University will be conducted by a post-doctoral researcher funded by the project. He stated that the intellectual property issues will need to be addressed. He responded well to a number of other questions regarding size/length scales, metals and crystallisation, surface energies during freezing. He felt that the most challenging aspects of project were microscopy and the application to material cracks. In response to questions regarding future impact, he stated that the main impact would probably be with the processing of porous materials for catalysis. The future sustainability of his research beyond the ERC Grant would be via a number of national funding opportunities.

In the detailed post-interview panel discussions, there were some concerns expressed about him possibly being not motivated to form an independent group beyond the ERC Starting Grant; however, it was universally agreed that the candidate is an excellent researcher and that the project is outstanding.

The panel therefore recommends the proposal to be retained for funding with a grant not exceeding 1 469 036.00 Euro.

REVIEWER COMMENTS

Reviewer 1

1. Intellectual capacity, creativity and commitment of the PI:

Notwithstanding reservations outlined below, this is an excellent proposal, by an outstanding researcher, in a field that is in desperate need of rigorous scientific attention.
The proposal is creative, expansive, timely and impressive. It is ground-breaking, goes beyond the state of the art, and it has the potential to open up new frontiers in colloid and materials sciences.
The project will allow the PI to establish an independent program, and make a notable mark early on in the career. This will serve as a solid foundation for the future career, and much can be expected of that, based on the apparent quality of this PI.
The previous publications are (in the main) world-class.
There appear to be three weaknesses:-
1 - omission of earlier pioneering work by Steytler et al. – this includes (basic) thermodynamic treatments and the approach of using pressure as a control variable (see points 2 and 3 below).
Structure and Interactions of Microemulsions in a Plastic-Crystalline Phase
J.Eastoe, B.H.Robinson, D.C.Steytler and J.C.Dore, Chem.Phys.Letts., 1990, 166, 153-58.
Steric Interactions Between Microemulsion Droplets in a Plastic-Crystalline Phase
J.Eastoe, B.H.Robinson, D.C.Steytler and J.C.Dore, in Food Polymers, Gels and Colloids, ed. E.Dickinson, RSC Special Publication No. 82, 1991, 469-76.
Effects of Solidification of the Oil Phase on the Structure of Colloidal Dispersions
J.Eastoe, B.H.Robinson, D.C.Steytler, I.P.Macdonald, K.Ibel and J.C.Dore, Langmuir 1993, 9, 903-11.
Measurement of Interparticle Forces from the Osmotic Pressure of Partially-Frozen Dispersions
J.Eastoe, B.H.Robinson, D.C.Steytler, I.P.Macdonald, K.Ibel and J.C.Dore, J.Phys.Cond.Matt 1996, 8, 953-56.
Interparticle Forces from Osmotic Pressure Measurements in Frozen Dispersions
J.Eastoe, B.H.Robinson, D.C.Steytler, I.P.Macdonald, K.Ibel and J.C.Dore, Surfactant Science Series ed. D.O.Shah, Marcel Dekker 1997, p 363 - 386.

2 – the effect of pressure (see papers above) is very important, and this has been overlooked in the experimental methodology. The reason for the utility of pressure is that liquid-solid transitions can be easily, quickly and reversibly triggered. Using pressure as a control variable is more flexible than relying solely on temperature (as is proposed here).

3 – use of other non-aqueous solvents, instead of water, allows use of higher temperatures, affords higher osmotic pressures, and therefore access to other compressed colloid structures. In addition, following the alternative solvent dimension, why have clathrate hydrates been omitted? Now it is possible to trigger solvent solidification at higher temperatures, also entrapping CO2 –which may have ramifications for carbon capture.

Commitment:
The PI is committed to the project, at the appropriate level.
The plans for research milestones, infrastructural and human recourse requests are appropriate. This is an intelligently crafted proposal which (on paper) should work well. The test will come for the PI in efficiently managing such a broad, diverse and ambitious plan.

2. Ground-breaking nature and potential impact of the research; methodology:

Ground-breaking nature and potential impact of the research:
Except for the limitations mentioned above, the proposal addresses the important challenges with respect to watery colloidal systems, and it is true that will be a great breakthrough.
The objectives are very ambitious, the program will certainly make important advances, and the approach is interestingly cross-disciplinary.

Methodology:
The impact from this project could be felt across science and engineering, being not just limited to the field of study (colloids and materials). There are no unconventional methodologies, but the sub-projects all use appropriate techniques (why not include SAXS/SANS?).

The requested recourses are all properly justified, and all collaborations proposed are ideal for making step-change progress.

Reviewer 2

1. Intellectual capacity, creativity and commitment of the PI:

The PI has very good records of outstanding publications. Some of papers are published in relevant journals as Science and Nature Materials. One of the papers published in Science has received 179 citations.
The PI worked in freezing of colloids during his postdoctoral stage at Lawrence Berkeley National laboratory. The results open a new bioinspired route to produce bioinspired materials.
The PI has demonstrated his ability to produce creative and independent work and his publications are ground-breaking nature.
The ERC starting grant will give a good opportunity to establish as independent researcher and to introduce a new field in Europe.
The PI is significantly committed to the project (65% of the working time).

2. Ground-breaking nature and potential impact of the research; methodology:

Ground-breaking nature and potential impact of the research:
This excellent proposal seeks to advance in a deeper knowledge of the phenomenon of freezing of colloids, to better control of the materials obtained through freezing colloids.
The real impact of the inter-disciplinary project is related with the development of bioinspired porous composites with outstanding mechanical properties.
The proposal will allow establishing and developing a frontier research in the field of materials science in Europe with numerous important applications in catalysis, biomaterials, microelectronics and energy production.

Methodology:
The project on understanding freezing colloids combines in a balanced way, an experimental approach (observing the freezing colloids in situ) with modelling of the process.
The proposal has been designed to incorporate a gradient of risk at several levels by combining novel approaches in observation techniques, modelling and characterization strategies. The project is divided in different partial objectives identifying in each objective the expected difficulties and the alternatives. The proposed methodology is detailed described and the milestones, timescales and resources are clearly identified.
The project will be developed in a CNRS joint lab partnering with the French company Saint Gobain in Cavaillon (France) which includes the majority of the necessary equipment for the project. Several other resources are available through the CNRS. Beam time will be bought to secure access to the synchrotron in Grenoble (40.000 € during 4 years).
The resources requested are justified and corresponds approximately to 50% for personnel (37% costs of PI, 40% PhD students). Other direct costs are mainly consumables.
The team is composed by PI (65% time), 3 PhD students and 2 postDoc hired during the entire duration of the project and one postDoc being hired and coached directly by Dr Peppin (researcher outside of the PI laboratory) during two years at Oxford Centre for Collaborative Applied Mathematics (OCCAM) in charge of the modelling development. The participation of the researcher outside of the PI lab is justified in order to coach the phase field modelling.

Reviewer 3

1. Intellectual capacity, creativity and commitment of the PI:

Good background in France and in the US working with strong teams in both places. Has written publications in high-class journals that have been widely cited. A very strong track record in terms of achievements. Proposed grant will develop his independence in terms of his role at CNRS - the grant will enable him to develop as an independent researcher and will enable him to create a strong experimental facility which can be used to generate leading-edge results. Investigator seems to be strongly committed to the project and will spend the right amount of time on it.

2. Ground-breaking nature and potential impact of the research; methodology:

Ground-breaking nature and potential impact of the research:
The area under study is one which is not well understood, although there are many papers on 'antifreeze peptides' which control crystallisation habit by (probably) selective adsorption onto some crystal planes, and Unilever understand enough to have launched commercial products containing such proteins in the US. It would have been useful to see some recognition of the work done in this field, which has included work on the crystallography of these systems. Controlling freezing is widely done and is understood on an empirical level in food manufacture, but the kind of understanding proposed in the project would be interesting and potentially valuable, in that it might be possible to develop methods to control morphology.

Methodology:
The experimental procedure is well described in the proposal and will hopefully work, enabling 3D visualisation of freezing in real time. The interaction between freezing fluid and the solid that is to be formed should also be readily visualised. The modelling part of the programme is slightly less well defined, in terms of the linkage between the experiments and the modelling, and the work to be done at Oxford - to what extent will modelling and experiment interact and what type of test systems will be used

Reviewer 4

1. Intellectual capacity, creativity and commitment of the PI:

The PI has significant achievements in the field of colloids and materials. He lists some 20 journal papers from 30 published. He has filed 3 patents. His work is truly multidisciplinary, covering materials, biology, mathematics, etc.
The PI's ground-breaking work has included the study of low-temperature ageing of ceramics.
The PI has demonstrated the ability to think creatively, beyond the state-of-the-art and shows the ability to work independently.
An ERC Starting Grant will enable the PI to consolidate independence.
The staffing funds requested suggest that the PI will be spending at least 50% of his time on the project.

2. Ground-breaking nature and potential impact of the research; methodology:

Ground-breaking nature and potential impact of the research:
The proposed research addresses the important field of colloid science.
The stated objectives are appropriately ambitious, and are expected to go substantially beyond the current state-of-the-art. The multiphysics of the problem as addressed at multi-scales. There is a distinct possibility of a major breakthrough in freezing processes related to of solid colloidal particles suspended in water.
The impact is expected to be significant in the fundamentals of colloid science, with many applications including soils, ocean, materials science, cryobiology, food engineering, microfluidics and biology.

Methodology:
The methodology is highly novel and unconventional. It is explained in good, clear detail, with relevant supporting data and diagrams. The timing of the specific activities could have been shown on a high-level Gantt chart. The scientific approach appears to be feasible.
The PI has addressed the issue of risk well and there is evidence that the proposal project has an appropriate balance of "high-gain/high-risk". The work could open up new fields of research in catalysis, biomaterials and energy production.

Reviewer 5

1. Intellectual capacity, creativity and commitment of the PI:

The PI was earned PhD at INSA Lyon in 2004. Immediately after that, he made a 2 years' stay as a Postdoctoral Fellow at the Materials Science Division of Lawrence Berkeley National Lab, USA implying his academic mobility. Actually, he has a position of tenured researcher at CNRS devoting himself mostly to research work.
The scientific track record of the PI is excellent and he already gains international reputation. He already published 30 peer-reviewed articles, 20 of which are listed in what he refers to as "selection of publications". His work appeared in prestigious and leading journals even with highest impact factors. The P.I. is the first author of 18 of the articles of the mentioned list. 9 of these articles are not co-authored by his PhD supervisor. One of these papers published in Science received 179 citations. In total, his publications resulted in over 580 citations. The applicant also has one patent granted and two patents pending. Some of his works has ground-breaking character. The PI has demonstrated his ability of creative and independent thinking. He is already in a more mature phase of his transition to scientific independence and excellence.
An ERC Starting Grant will definitely make a significant contribution to the establishment of the PI's independence as a researcher and even more important for creating and leading own research team. Therefore, the candidate is strongly committed to the project and has made a careful choice of the team members.

2. Ground-breaking nature and potential impact of the research; methodology:

Ground-breaking nature and potential impact of the research:
The proposed research is highly multi-disciplinary at the borderline of material and colloid science, involving chemistry, physics, and mathematics. The project addresses important challenges at the frontiers of materials sciences dealing with freezing hydrocolloids as innovating bio inspired processing route for obtaining of specific materials. The proposal will allow establishing and developing a frontier research in the field of colloid science applied for obtaining of materials with advanced properties and possible applications in catalysis, biomaterials, microelectronics and energy production. The project is very well conceived and organized and the objectives are very ambitious. There is a real possibility of a major breakthrough in freezing processes related to of solid colloidal particles suspended in water – hydrocolloids.

Methodology:
The proposed research involves a combination of new approaches and unconventional methodologies. The PI will combine experimental work with computational modelling of the freezing process using highly interdisciplinary approach to solve research problems and to gain project objectives. The impact is expected to be significant in the fundamentals of colloid science, with many applications including materials science, cryobiology, food engineering, regenerative medicine and biology. The potential impact will be great even if the very ambitious scientific program cannot be fully accomplished. The project proposal contains sufficient information on the size and scientific profiles of the researchers involved in experimental and computational work making the project feasible. The PI has described precisely the risk analysis and there is evidence that the proposal project has an appropriate balance of "high-gain/high-risk".
The host environment provides most of the infrastructure necessary for the project proposed. The host institution is in position to provide an infrastructural support and intellectual environment to meet the expectation of PI and the ambitions of the project since posses all necessary experimental set-up and reference power plant as a platform for investigation. The research activities will be conducted by 5 host researchers including 3 PhD students and 2 postdoctoral fellows over 5 years of the project and supervised by PI (65 % of his working time will be dedicated to the project). In particular, one researcher outside of PI host institution will be in charge of the modelling development working at Mathematical Institute at the University of Oxford. The expertise of the suggested researcher for computational modelling and additionally hired postdoctoral student from this entity would substantially enhance the project.