EUROPEAN SYNCHROTRON RADIATION FACILITY

INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON

ESRF

Experiment Report Form

The double page inside this form is to be filled in by all users or groups of users who have had access to beam time for measurements at the ESRF.

Once completed, the report should be submitted electronically to the User Office via the User Portal:
https://wwws.esrf.fr/misapps/SMISWebClient/protected/welcome.do

Deadlines for submission of Experimental Reports

Experimental reports must be submitted within the period of 3 months after the end of the experiment.

Experiment Report supporting a new proposal ("relevant report")

If you are submitting a proposal for a new project, or to continue a project for which you have previously been allocated beam time, you must submit a report on each of your previous measurement(s):

- even on those carried out close to the proposal submission deadline (it can be a *"preliminary report"),*
- even for experiments whose scientific area is different form the scientific area of the new proposal,
- carried out on CRG beamlines.

You must then register the report(s) as "relevant report(s)" in the new application form for beam time.

Deadlines for submitting a report supporting a new proposal

- 1st March Proposal Round - **5th March**
- 10th September Proposal Round - **13th September**

The Review Committees reserve the right to reject new proposals from groups who have not reported on the use of beam time allocated previously.

Reports on experiments relating to long term projects

Proposers awarded beam time for a long term project are required to submit an interim report at the end of each year, irrespective of the number of shifts of beam time they have used.

Published papers

All users must give proper credit to ESRF staff members and proper mention to ESRF facilities which were essential for the results described in any ensuing publication. Further, they are obliged to send to the Joint ESRF/ ILL library the complete reference and the abstract of all papers appearing in print, and resulting from the use of the ESRF.

Should you wish to make more general comments on the experiment, please note them on the User Evaluation Form, and send both the Report and the Evaluation Form to the User Office.

Instructions for preparing your Report

- fill in a separate form for each project or series of measurements.
- type your report in English.
- include the experiment number to which the report refers.
- make sure that the text, tables and figures fit into the space available.
- if your work is published or is in press, you may prefer to paste in the abstract, and add full reference details. If the abstract is in a language other than English, please include an English translation.

ESRF	**Experiment title: "Investigation of the effect of gallium ion on the overall medical glass structures"**	**Experiment number**: 26-02-1170
Beamline: BM26A	**Date of experiment**: from: August 27th 2018 to: August 30th 2018	**Date of report**: June 24th 2019
Shifts: 9	**Local contact(s)**: Dr. Dipanjan Banerjee	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Daniel Hermida Merino – Dubble/ NWO

Bing Wu* – Dubble/Royal College of Surgeons in Ireland

Report:

Alginate is a biomaterial that has promise in numerous biomedical applications due to its favourable properties, including biocompatibility and ease of gelation. Alginate hydrogels have been particularly attractive in wound healing, drug delivery, and tissue engineering applications, as these gels retain structural similarity to extracellular matrices and can be manipulated to play several critical roles. The gelation rate is a critical factor in controlling uniformity and strength when using cross-linking cations, and slower gelation produces more uniform structures and greater mechanical integrity. One critical drawback of ionically cross-linked alginate gels is the limited stability under physiological conditions, as these gels dissolve by releasing divalent ions into the surrounding media in exchange for monovalent cations. This replacement of divalent ions with monovalent ions occurs with all ionically cross-linked alginates currently discussed in the literature. In order to avoid this exchanging, we developed a novel glass-based formulation, where the alginate material has controllable setting kinetics and strengthens over time under physiological conditions due to a slow and continuous release of di- and tri-valent ions from the glass phase.

This continuous release of ions from the glass phase is dependent on producing a stable glass structure wherein there is a large number of charge balanced tri-valent gallium ions which form a tetrahedral structure with the silicon and phosphorous ions in the glass, maintaining a high network connectivity (NC) within the glass but allowing the glass to be liable to acidic attack. This tetrahedral acid liable structure has previously been shown to exist in the glass ionomer cement structure by using aluminium ions. However, aluminium ions, unlike gallium ions, have been shown to be neurotoxic and have been implicated in the pathogenesis of Parkinson's and Alzheimer's disease. To the contrary, gallium has been shown to illicit antibacterial, anti-inflammatory and anti-tumour propertie. As shown in Figure 2, even after 48 hours of ion

release, the neat eluent from the injectable did not cause any significant change in cell viability for Bovine aortic smooth muscle cells (BASMCs).

By performing the in-situ EXAFS-XANES analyses of these injectables with different gallium ratio, the tetrahedral/octahedral ratio of gallium in the medical glasses and its change during the degradation period of the injectable would be understood in correlation with the gel strength studies done before.

In this study, both ex-situ analyses of analyses and insitu analyses on the Ga-based galsses were analyzed. As show in Figure 1, the change in the weight ratio between Ga:Al does not affect the coordination of Ga inside these glass systems. The whole Ga K-edge FT EXAFS peak can be fitted with a distorted tetrahedral model, the evolution of this peak suggested a 2 stage formation of this Ga-based hydrogel in GDL solution.

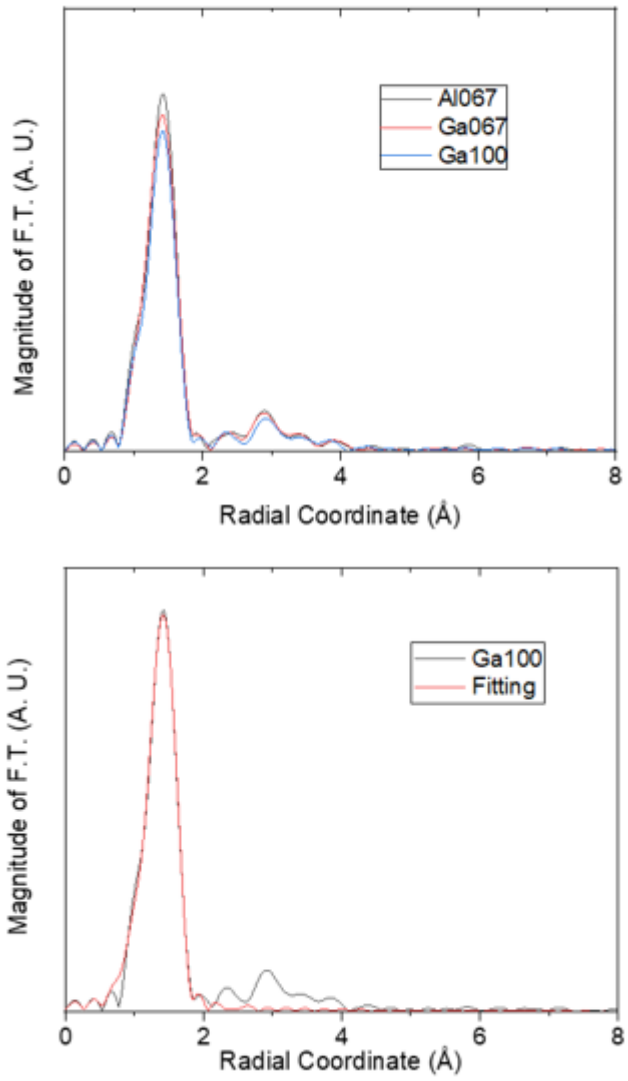

Figure 1. FT Ga K-edge EXAFS Spectra of all the samples (top); Fitting of FT Ga K-edge EXAFS Spectrum of GA100 (bottom).

The set of experiments promotes the understand of the formation and evolution of this Ga-based medical glasses in acid soluton (GDL), and the manuscript is under prepartion.