

JSPS Short Term Award – Report

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Host Institution: Nagoya Institute of Technology, Department of Frontier Materials

Host Researcher: Prof. Toshihiro Kasuga

Length of Fellowship: 4 months (1 March to 30 June 2010)

Current position: Postdoctoral researcher at Queen Mary University of London, Unit of Dental Physical Sciences

Research Summary

Bone can heal itself if the defect is small, but for larger defects (e.g. due to trauma or removal of tumours) degradable implant materials based on phosphate glasses can help the body to regenerate. Phosphate invert glasses are water soluble and consist of small phosphate groups (pyro- and orthophosphate). They give a neutral pH in aqueous solutions in contrast to metaphosphate glasses, which give acidic degradation products and have negative effects on cells, body tissue or polymer degradation in composites. However, due to their structure consisting of small phosphate units, phosphate invert glasses have high crystallisation tendencies, which makes fabrication of sintered porous scaffolds or glass-fibres for reinforced composites challenging. Titanium oxide was shown to effectively decrease crystallisation and improve the processing window, but it also decreases glass solubility significantly.

As an alternative method for decreasing the crystallisation tendency of the glasses, we investigated increasing the number of glass components. This would be expected to increase the enthalpy of mixing and thereby stabilising the amorphous glassy state. In a glass system P_2O_5 -CaO-MgO- Na_2O - TiO_2 we partially substituted strontium for calcium, zinc for magnesium and potassium for sodium. We then studied the thermal behaviour of the multi-component glass, the base glass (strontium-, zinc- and potassium-free) and a titanium-free version of the base glass. Results showed a significant increase in the processing window (i.e. the temperature range between glass transition temperature and the onset of crystallisation) with both incorporation of TiO_2 and with an increase in the number of glass components.

In addition, we studied several additional new glass series, to investigate the influence of certain components (magnesium, strontium, fluoride) on glass structure and properties.

Life in Japan

The four months I spent in Japan were a very rewarding experience, both scientifically and in general. Although working in a Japanese research group is very different from my experiences in Europe and the US, I did not experience any difficulties settling in, which was mostly due to the fact that everybody in the group was very supportive and helpful, and everybody tried their best at speaking English with me – which I appreciated particularly, as my Japanese was rather basic. Also, over the first days of my stay in Japan, my co-workers helped me to settle in and went with me to register, open a bank account, find a flat and even to buy household goods.

Japanese research groups have more similarities with a big family rather than a European or North American research group: Researchers and students spend most of their time at work, and subsequently people do their best to get on very well with each other and minimise competition or difficulties, which promotes a highly collaborative and supportive work environment.

Initially, I imagined life in Japan would be difficult to adapt to, mostly because of cultural differences; however, I did not experience any major issues myself. Although most people are not fluent in English, I have found them to make a big effort for my sake and with a bit of patience (both on my part and theirs) I found it very easy to get around. Of course knowing a

few polite phrases in Japanese make things a little easier. While some people seemed to be a bit scared of either me or of having to speak English with me, many other (particularly older) people seemed quite excited to meet me (i.e. a blond foreigner). In addition, I have been a huge fan of Japanese food for a long time, and enjoy eating with chopsticks and my time in Japan was a great culinary experience. (Although I expect it to be very difficult for vegetarians.)

Nagoya is probably not the most attractive city from a tourist point of view, but I enjoyed the high quality of life there: It is easy to navigate (by public transport which has signs in English in addition to Japanese, by bicycle or walking), it offers some attractive sightseeing spots such as Nagoya Castle, Atsuta Shrine or Osu Kannon, there are plenty of good restaurants and I had a lovely apartment close to campus. (The latter point is in particular contrast to my life in London.) But Nagoya also is very conveniently located to visit other parts of Japan, as it is situated in the geographical centre of Japan and Kyoto, Nara, Osaka, Takayama, Nagano or Tokyo are easily reached by public transport.

I was lucky enough to have time for travelling and seeing some of Japan, a country I have wanted to explore for many years. I travelled to Kyoto and Nara during the cherry blossom season, visited smaller cities such as Takayama and Gujo Hachiman, hiked the old Nakasendo between Magome and Tsumago and did several day trips near Nagoya to places such as Inuyama, Gifu (to watch cormorant fishing) and Tokoname, the pottery town. In addition, I was able to combine a visit to Kyushu University in Fukuoka with a trip to Nagasaki and Unzen.

I recommend a research stay in Japan to anybody who is interested in and open minded to experiencing other cultures and patient enough to accept that things do tend to take a little bit longer if one does not speak the language.



myself with cherry blossoms in April



Nagoya Castle



Nagoya Institute of Technology



Prof. Kasuga's group