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# The Evolution of Surface Silica Nanoparticles on Coated Steel Surfaces under High UV and High Humidity Environments Observed Using Synchrotron Macro ATR-FTIR Microspectroscopy

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Corrosion of metallic surfaces is prevalent and of great concern in a wide range of industries, particularly those in transport, aviation, building and food sectors, reportedly responsible for a direct cost of $276 billion per annum(1). Galvanization has been widely used as a corrosion preventative method by coating the metallic surfaces with zinc that serves as a physical barrier to prevent corrosive substances from reaching the underlying metal. In tropical and sub-tropical climates with prolonged exposure to high UV and high humidity, thermosetting polymer coatings based on polyesters have also been used to provide an additional protection to the galvanized metal. This prevents the build-up of moisture within the pits present on the metallic surface where the zinc oxide passive film is weak, leading to localized corrosion(2). Recent advances in surface engineering using silica nanoparticles (SiO2NPs) have allowed the development of innovative and highly functional surface coatings with enhanced corrosion resistance and durability(3). Nevertheless, long-term effect of environmental factors upon these materials remains unknown.

In this study, chemical evolution of SiO2NPs-embedded polyester coatings on steel substrata was analysed after 5 years of exposure to tropical/sub-tropical environments in Singapore and Australia using synchrotron-based macro ATR-FTIR microspectroscopy and surface topographic techniques. Principal component analysis (PCA) based on FTIR spectral data observed at 9% SiO2NPs shows differences in their response to environmental factors between the control group and the surfaces subjected to 3-year exposure. The clustering feature suggests changes in molecular structure of the coating resulted from the exposure, which principally involved triazine ring vibration in the melamine resins. Such molecular evidence corroborates well with the fact that the triazine ring is very sensitive to hydrolysis, particularly under high humidity conditions in tropical environments.

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**References:**

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## Keywords or phrases (comma separated)

Synchrotron infrared, surface coating, steel, polyester, nanoparticles

## Are you a student?

No

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No

## Are you an ECR? (<5 yrs</br>since PhD/Masters)

No

## What is your gender?

Female

**Primary author(s) :** Dr VONGSVIVUT, Jitraporn (Pimm) (Infrared Microspectroscopy (IRM) Beamline, Australian Synchrotron, 800 Blackburn Road, Clayton, Victoria 3168, Australia)

**Co-author(s) :** Prof. IVANOVA, Elena (School of Science, Faculty of Science, Engineering and Technology, Swinburne University of Technology, Hawthorn, Victoria 3122, Australia); Dr TOBIN, Mark (Infrared Microspectroscopy (IRM) Beamline, Australian Synchrotron, 800 Blackburn Road, Clayton, Victoria 3168, Australia); Prof. J. CRAWFORD, Russell (School of Science, RMIT, Melbourne, Victoria, 3000, Australia); Dr MACLAUGHLIN, Shane (BlueScope Steel Research, Port Kembla, New South Wales 2505, Australia); Dr TRUONG, Vi Khanh (School of Science, Faculty of Science, Engineering and Technology, Swinburne University of Technology, Hawthorn, Victoria 3122, Australia)

**Presenter(s) :** Dr VONGSVIVUT, Jitraporn (Pimm) (Infrared Microspectroscopy (IRM) Beamline, Australian Synchrotron, 800 Blackburn Road, Clayton, Victoria 3168, Australia)

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