An ATR Investigation of Coatings on Glass

Figure 1. The DiaMaxATR™.

INTRODUCTION

Coated glass is used in a wide range of industries including packaging, auto-motive, architecture, appliance and décor. Some of the coatings are applied to the hot glass during annealing for increased durability and hardness, while others are applied once the glass has been cut to size. Glasses are coated to influence their mechanical and chemical properties, increasing longevity and durability, their optical properties, imparting UV-protection or color, and their thermal properties, for improved insulation.

This application note explores the possibility of examining these types of coatings on glass using FTIR single reflection diamond ATR.

EXPERIMENTAL

Spectra were obtained on a FTIR spectrometer equipped with the DiaMaxATR™ high throughput diamond ATR. Five samples were examined: fresh soda lime silica glass, corroded silica glass and three coated glasses. The samples were pressed against the ATR crystal using the maximum force allowed by the pressure applicator. Spectra were collected relative to the clean ATR crystal, from 4000 to 650 cm^{-1} using 32 scans at a resolution of 8 cm^{-1}.

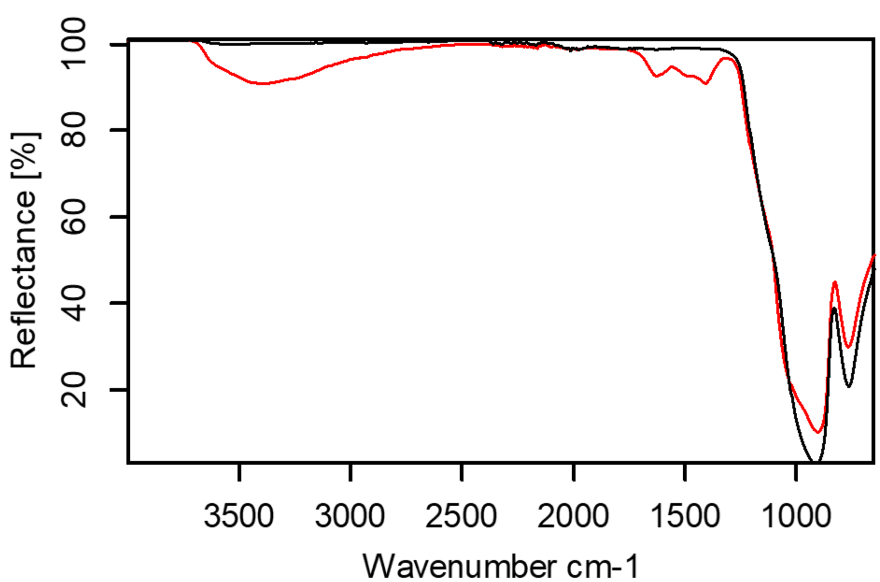
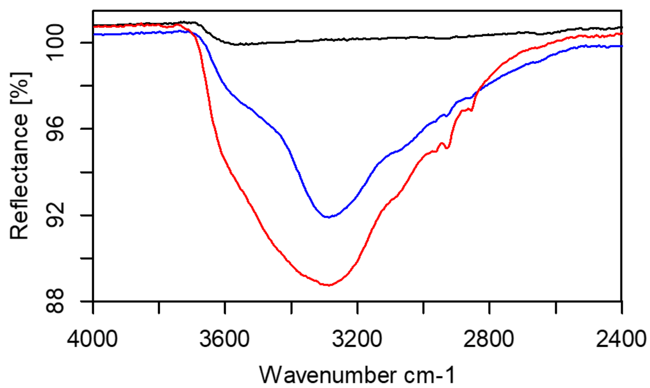


Figure 2. The ATR spectra of fresh soda lime silica glass (black) and corroded soda lime silica glass (red).



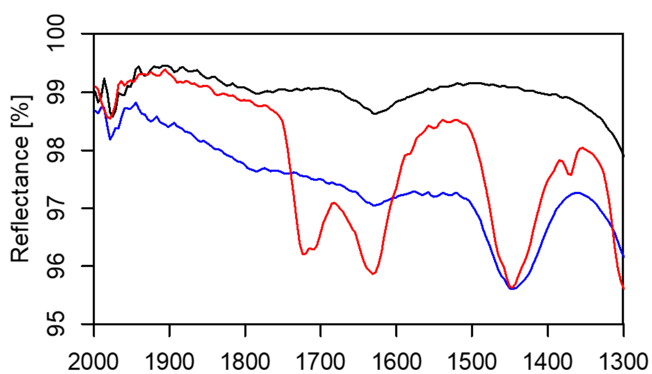


Figure 3. The ATR spectra of three coated glasses (red, blue and green) compared to fresh glass (black).

RESULTS AND DISCUSSION

While glasses are generally considered chemically inert, they can be attacked by both acids and alkalis. The most well-known circumstances are reaction upon exposure to hydrofluoric acid, phosphoric acid and high temperature water. But glass also is susceptible to surface corrosion upon exposure to vapors in the air and their condensates.

Figure 2 shows the spectra measured from fresh silica glass and corroded silica. As expected, the corroded glass shows more intense bands in the OH stretching region. Additional bands are also present in the corroded silica at 1633 cm^{-1} which is likely due to the bending mode of adsorbed water and bands at 1495 cm^{-1} and 1410 cm^{-1} which may be due to free OH^-. Both of these glass show bands in the 1200-650 cm^{-1} range due to the Si-O-Si vibrations.

Figure 3 shows the spectra of two coated soda lime silica glass samples in comparison to the fresh glass. The two coated samples have a much richer structure in the OH stretching region than either the fresh silica or corroded silica, indicating that the OH is bound in a variety of different ways to the surface[1]. The bands in the 1500-2200 cm^{-1} region are generally attributed to the Si-O-H···O-Si stretches and bends[2]. The differences are likely due to various inorganic additives in the coatings which shift the bands and change their intensities.

CONCLUSION

Differences between coatings on glass can be detected using a high throughput diamond ATR accessory like the DiaMaxATR.

1. R.L. DeRosa et al., *Journal of Non-Crystalline Solids* **331** (2003) 32–40.
2. A.M. Efimov et al., *Journal of Non-Crystalline Solids* **332** (2003) 93–114.

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