Analysis of Fig. 3.14 shows that the spectra contain three distinct zones (A, B, and C) of chemical shifts, so indicating three different chemical environments around fluorine:

- fluorine is surrounded by calcium (area A),
- fluorine is surrounded by sodium (area C), and
- fluoride is surrounded by both sodium and calcium (area B).

These entities are not bound to the silicate network but are inserted into the interstices of the glass; so the fluorine does not modify the silicate network constituting the oxynitrides.

3.4.5 Physicochemical Properties of Si-Ca-Na-O-N and Si-Ca-Na-O-F-N Glasses (Bachar et al., 2013b)

The incorporation of nitrogen into both GNx and GFNx systems increases the glass transition temperature, Tg (Fig. 3.15).

Two relations linking Tg as a function of the mass percentage of nitrogen can explain this increase:

$$\mathrm{Tg}(\mathrm{GNx}) = 505.1 + 18.27 \times (\%\mathrm{N})$$

$$\mathrm{Tg}(\mathrm{GFNx}) = 473 + 21.14 \times (\%\mathrm{N})$$

The introduction of fluorine significantly reduces the glass transition temperatures, for example: Tg = 505.1°C for GN0 glass and 473°C for GFN0 glass. This results from a higher compactness of the networks and therefore a decrease

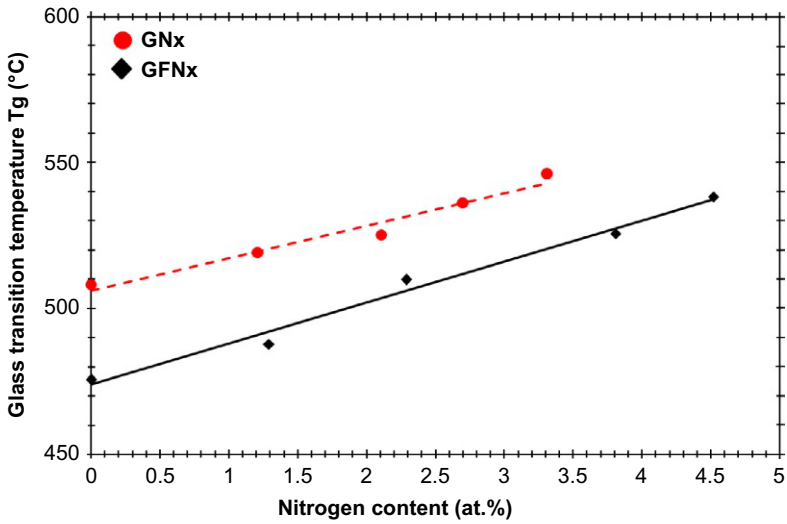

FIG. 3.15 Glass transition temperature (Tg) as a function of N content for GNx and GFNx glasses.