because of the numbers of parameters to be considered. The studies are also, and for the same reasons, delicate to compare.

Moreover, many contradictions have been highlighted in the bibliography. Indeed, the definition of the notion of bioactivity varies according to the author (Hench, 1990; Andersson et al., 1990; Brink et al., 1997; Ogino and Hench, 1980; Ohura et al., 1991; Ebisawa et al., 1990).

It was interesting to begin by studying the influence of the three basic compounds (SiO_2, CaO, and Na_2O) on the properties of the bioactive glasses.

Then, the influence of the addition of other constituents has been tested in the other parts of this chapter.

3.1.2 The SiO_2-CaO-Na_2O System

3.1.2.1 Overview

In this chapter, the bioactivity of the glasses has been evaluated by soaking them in a simulated body fluid (SBF). The evolutions of the nucleation times of the HCA layer and its thickness have been analyzed.

For each sample, different analyses were carried out in order to establish the bioactivity property and compared to Bioglass 45S5, chosen as a reference.

The nucleation time of HCA on the sample surface, which has been defined as the bioactivity property in our case, has been determined by Fourier Transform Infrared S (FTIR) spectroscopy. Scanning Electron Microscopy coupled with Energy Dispersion Spectroscopy (SEM-EDS) was used to characterize the layers and to measure the thicknesses.

In order to achieve the nucleation of a layer of HCA on the surface of a bioactive glass, the latter has to undergo several surface modifications, summarized in Table 3.1.

These modifications follow the bioactivity mechanism proposed by Hench (1990), even if a multitude of other mechanisms have been proposed.

Fig. 3.1 shows the infrared spectrum of Bioglass 45S5 soaked in SBF versus soaking time; the evolutions, corresponding to each reaction stage, are detailed in Table 3.1.

For Bioglass 45S5, the silica gel develops before 4 h of immersion in SBF, amorphous apatite from 4 h and is crystallized at 12 h.

3.1.2.2 Selection of Compositions

Fifteen compositions were chosen based on previous studies (Andersson et al., 1990; Brink et al., 1997; Kim et al., 1995).

The compounds contain oxides, some of which are network formers (SiO_2), and other modifiers (CaO and Na_2O). These are, in most cases, invert glasses, containing an exceptionally low relative level of network-forming oxides with silica contents of around 40 mol%. In these glasses, the silica (SiO_2) content is so low that the formation of a three-dimensional network of bonded SiO_4 units (being for traditional glasses) is no longer possible and the resulting parts are isolated in small chains.