uptake in comparison with the corresponding native matrices. In fact crossing the hydrogel, the $CO_2$ bubbles mechanically provoke the approach of the polymeric chains of the hydrogel. Furthermore the acidic $CO_2$ bubbles crossing the matrix induce a local lowering of pH and provoke the protonation of COO-, with the consequent hydrogen bonds formation (Fig. 14). As a consequence the rheological properties of the porous hydrogels are enhanced compared to the hydrogels without pores (Leone et al. 2004).

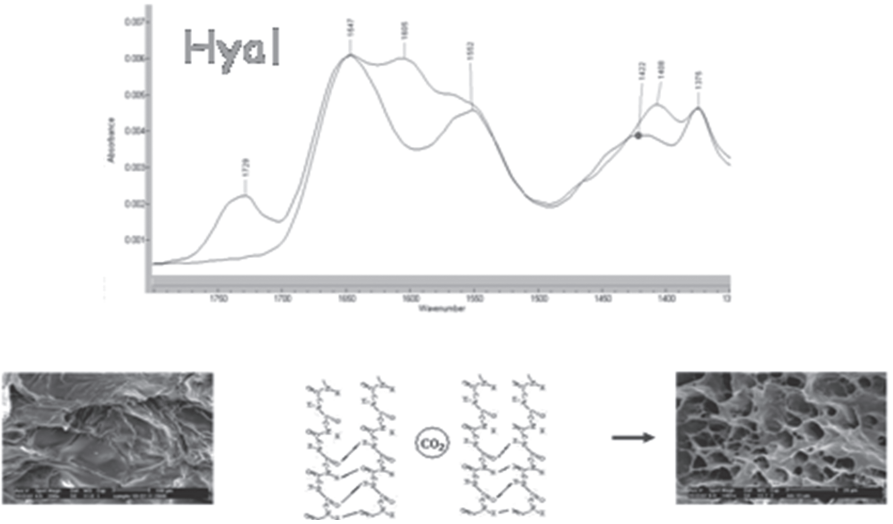


**Fig. 14.** Infrared spectra of the porous Hyal gel in comparison with that of the native Hydrogel. A new band at 1729 $cm^{-1}$ appears, ascribed to the protonated carboxylic groups hydrogen bonded Infrared spectra of the porous Hyal gel in comparison with that of the native Hydrogel. A new band at 1729 $cm^{-1}$ appears ascribed to the protonated carboxylic groups hydrogen bonded (Leone et al. 2004).

The analysis of the porous structure of hydrogels in a freeze-dried state can be carried out by the Confocal Laser Scanning Microscopy (CLSM) which provides information on changes in the hydrogel structure during and/or after drying (Savina et al. 2011) (Fig. 15). Fluorescein isothiocyanate (FITC) stained Poly 2-hydroxyehylmetacrylate-allylglycidylether (HEMA-AGE) gel was freeze-dried and CLSM image of the dried sample was compared with that obtained for hydrated hydrogel. This comparison shows that changes in the porous structure of the gel after freeze-drying were insignificant.

## Mechanism of Swelling

In the dried state the hydrogels are a composite of a solid material (polymers and crosslinkers), small amount of water, mainly due to bound water, and air present in the pores, as shown in Fig. 16.

While the swelling capacity of hydrogels is the sole function of the solid content of the composite, the mechanical properties are a function of all elements—solid, liquid,