result in some sample-related effects, such as preferred orientation, microabsorption and 'rock-in-the-dust/graininess' effects, all powders were characterized by scanning electron microscopy (SEM). Fig. 3.10.2 shows SEM micrographs for all of the phases. All inorganic samples were single phases except for gypsum and insoluble anhydrite. The impurity-phase contents for these two samples were reported in León-Reina *et al.* (2016).

Both organic and inorganic phases were also measured using Cu $K\alpha_1$ radiation in reflection mode. As expected, a transparency effect was observed in the Cu $K\alpha_1$ patterns for organic samples (Buhrke *et al.*, 1998).

3.10.6. Limits of detection and quantification

LoD and LoQ are two important quantities in the validation of any analytical method. LoD/LoQ are terms that are used to describe the smallest concentration of an analyte that can be reliably detected/assessed by an analytical procedure, as discussed in Section 3.10.1. In techniques such as Rietveld analysis, the approach of having a powder pattern with its strongest (not overlapped) diffraction peak with an S/N ratio of larger than 3.0 is not straightforward because the full powder pattern is evaluated.

Fig. 3.10.3 shows Mo $K\alpha_1$ and Cu $K\alpha_1$ raw patterns for the inorganic series with increasing amounts of insoluble anhydrite (labelled with solid squares) and Fig. 3.10.4 shows the strongest diffraction peak for i-A in the mixtures containing 0.123 wt% anhydrite (CGpQ_0.12A) and 0.25 wt% anhydrite (CGpQ_0.25A) to evaluate the limits of detection in the conditions reported in Section 3.10.5. For CGpQ_0.12A, both laboratory powder patterns yielded peaks with S/N ratios lower than 3.0 (top panels in Fig. 3.10.4). For CGpQ_0.25A, the Cu $K\alpha_1$ pattern yielded a clear peak with S/N = 4.1; therefore, it can be concluded that the LoD for insoluble anhydrite with this radiation in this mixture is slightly lower than 0.2 wt%. For Mo $K\alpha_1$ radiation, the CGpQ_0.25A and CGpQ_0.50A samples yielded patterns with peaks with S/N ratios of 2.4 and 5.1, respectively. Hence, it can be concluded that the LoD for i-A with this radiation in this mixture is quite close to 0.3 wt%.

The LoQ for i-A in this matrix was also studied. Three Mo $K\alpha_1$ and Cu $K\alpha_1$ patterns were collected for CGpQ_0.12A. For the three Mo $K\alpha_1$ patterns, the average analysis result for i-A was 0.28 (2) wt%, but the accuracy of the obtained value is poor, as the expected value was 0.12 wt%. Similarly, the average value for the analyses of three Cu $K\alpha_1$ patterns was 0.24 (2) wt%. The RQPA results are given as supporting information in León-Reina *et al.* (2016). It was concluded that i-A can be quantified in this mixture at the level of 0.12 wt%, but with a relative error close to 100%. If the 'acceptable reliability' criterion in the analysis is taken into consideration, the LoQ value would be close to 1.0 wt% in order to have a relative associated error lower than 20%.

CGpQ_0.12A was also studied by SXRPD. Fig. 3.10.3(*c*) shows the SXRPD patterns collected at three different positions of the capillary, which were almost identical, and Fig. 3.10.4 (bottom left) shows the main diffraction peak of anhydrite. The S/N ratio for the strongest diffraction peak of anhydrite was 12.8 and hence the limit of detection for i-A with synchrotron radiation in this matrix is below 0.10 wt%.

To quantify the accuracy of the analyses, the KLD methodology was used. The AKLD values for each analysis as well as the KLD values for i-A are reported in León-Reina *et al.* (2016). The synchrotron analyses clearly had better accuracy than those using laboratory radiation. Moreover, the Mo $K\alpha_1$ radiation analyses were slightly better than those obtained using Cu $K\alpha_1$ radiation.

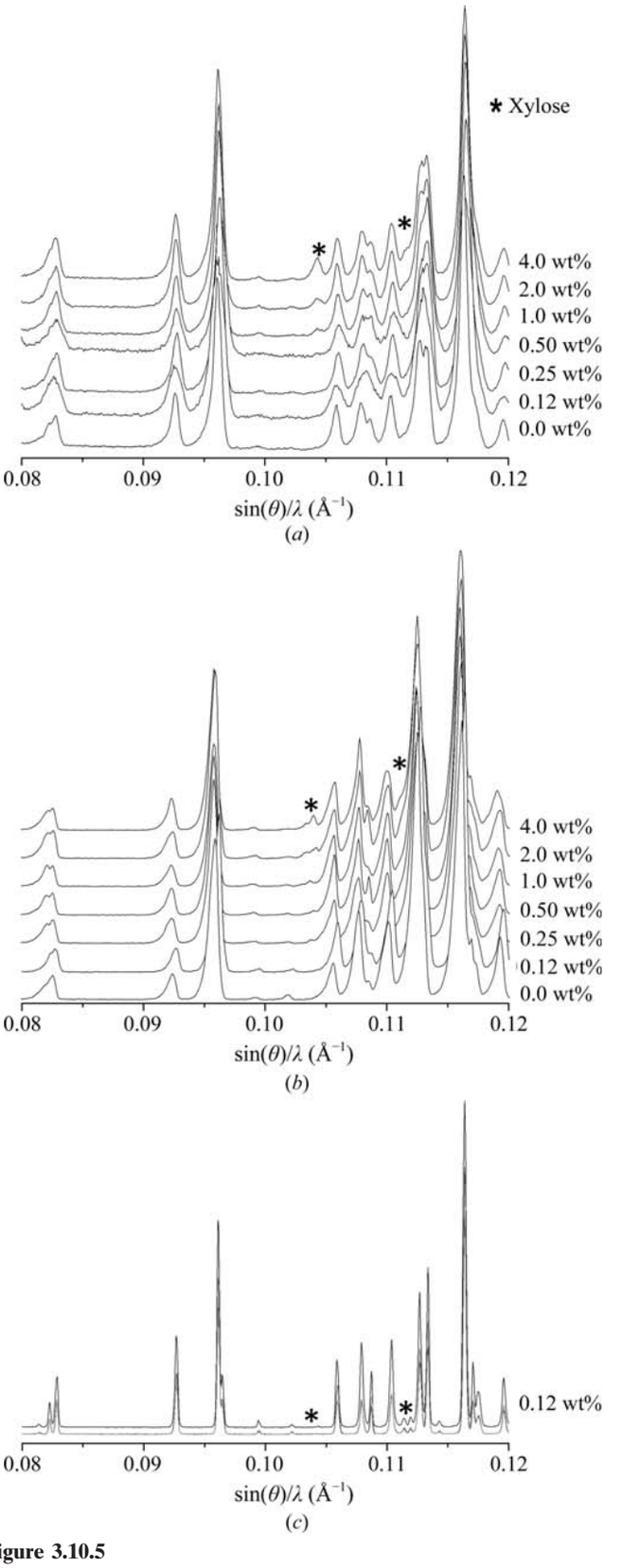

Figure 3.10.5
(*a*) Raw Mo $K\alpha_1$ powder patterns for the organic series composed of a constant matrix of glucose, fructose and lactose, and increasing amounts of xylose (peaks highlighted with an asterisk). (*b*) Raw Cu $K\alpha_1$ powder patterns for the same organic series. (*c*) Raw SXRPD patterns for GFL_0.12X collected at three different positions of the capillary (as collected).