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Dynamic-tracking desorption of CO_2 in Champagne wine using infrared thermography

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Due to its particular elaboration process, Champagne wine is a supersaturated beverage containing high volumes of CO_2 dissolved gas molecules; one estimates there are about 5 L of gaseous dissolved CO_2 in a 0.75 L classical Champagne bottle. Over past years, numerous studies on Champagne wine have focused the way effervescence process occurs in tasting conditions due to CO_2 release. More recently, the consequence of effervescence and nucleation process on the mixing phenomena of Champagne liquid medium has been highlighted by laser tomography (Polidori et al. 2008, 2009). This was based on the strong idea that a relationship may exist between the mixing flow patterns and the dynamics of CO_2 fluxes outgassing from the glass, mainly responsible for the Champagne aroma exhalation process. It is worth noting that two pathways exist for dissolved CO_2 to escape from the liquid medium (Liger-Belair et al. 2008, 2009): (a) into the form

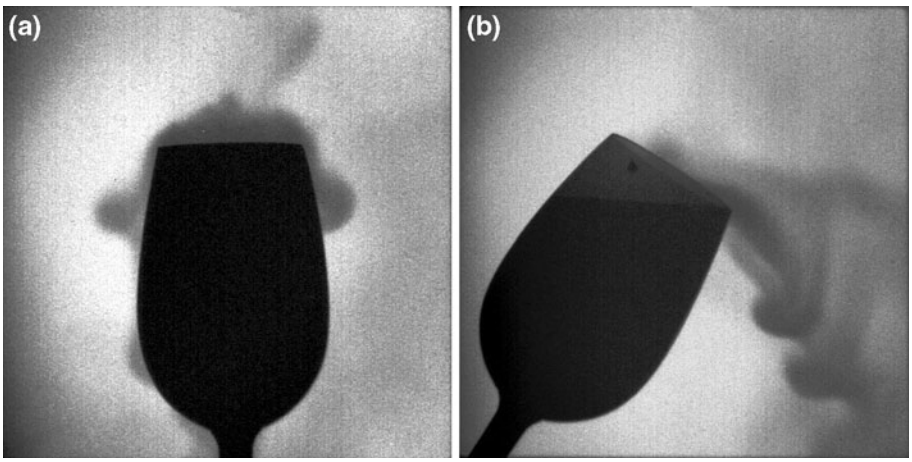

Fig. 1 Visualizations of CO_2 fluxes outgassing from the Champagne glass after pouring: vertical flute glass (**a**), inclined flute glass in tasting condition (**b**)

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of bubbles that collapse at the free surface and (b) by "invisible" diffusion through the interface between air and Champagne. In order to understand better how "invisible" diffusion occurs, a visualization technique based on the IR thermography principle (Gordge and Page 1993) has been used, to make visible the CO_2 fluxes outgassing from a glass containing Champagne wine, after pouring. The CO_2 absorptions observable by the IR camera are quite weak because this gas has only a strong emission peak in the detector bandwidth at 4.245 μm. So, the best way to visualize CO_2 flowing from the glass is to have a band-pass filter (centred on the CO_2 emission peak) on the camera. The experiment device consists of a *CEDIP middlewaves titanium HD560M* IR camera coupled with a CO_2 filter (Ø50.8 mm × 1 mm thick, *Laser Components SAS*). In complement, the technique involves an extended blackbody (*Ci systems* provided by *POLYTEC PI* of 80°C spatial controlled temperature and known emissivity placed approximately 30 cm behind the glass combined with an image subtraction process. Figure 1a, b reveals how CO_2 desorption occurs in Champagne flutes. Because the CO_2 density is higher than that of air ($\rho = 1.87$ g/L), fluxes are shown to escape downward from the glass, evidencing the major role diffusion plays in the CO_2 outgassing process.

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