DROP IMPACT ONTO A SURFACE COVERED WITH A THIN FILM

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Despite being encountered in various natural and applied cases where a drop impacts a very thin film made of an immiscible liquid (e.g. water impact onto an oil covered surface) there is little experimental or numerical studies available. Experimentally we investigated both the spreading and recoiling phases of the drop impact for such systems. Similar to miscible systems, in the spreading phase of the impact phenomena for when droplet and film are made of immiscible liquids, one observes (see Fig. 1): (i) simple spreading; (ii) crown formation without splashing; and (iii) splashing. However, for a miscible film, a larger impact Weber number (*We*) and film thickness are needed for the formation of a crown and splashing comparing with immiscible cases. The other difference is that when the film is very viscous (e.g. 100 cSt), the spreading of the drop on an immiscible film is similar to that of drop impact onto a dry surface, unlike the impact onto a miscible viscous film. Contrary to intuition that here will not be a recoiling phase for two miscible liquids, while one expects recoil could be observed for two immiscible liquid, we found that the immiscibility is not a necessary condition for the existence of a recoil phase. The presence of a recoil phase is highly dependent on the value of the interfacial tension between the drop and the film. The larger the interfacial tension difference, the more noticeable the recoiling phase can be. Even a total rebound can be seen for systems with large liquid-liquid interfacial tension values. The occurrence of the total rebound is affected by the substrate wettablity, *We*, film thickness and film viscosity. It was found that the oil film can rupture during the impact process when the substrate has a contact angle <90^{o} with the liquid of the droplet; in such case, the total rebound will be impeded. Instabilities of the lamella (e.g. fingering, crown, and splashing) during the spreading phase also hinder the total rebound. Finally, a total rebound was absent for drop impact onto viscous films (e.g. 100 cSt) due to significant energy desperation during the spreading and recoil phases.

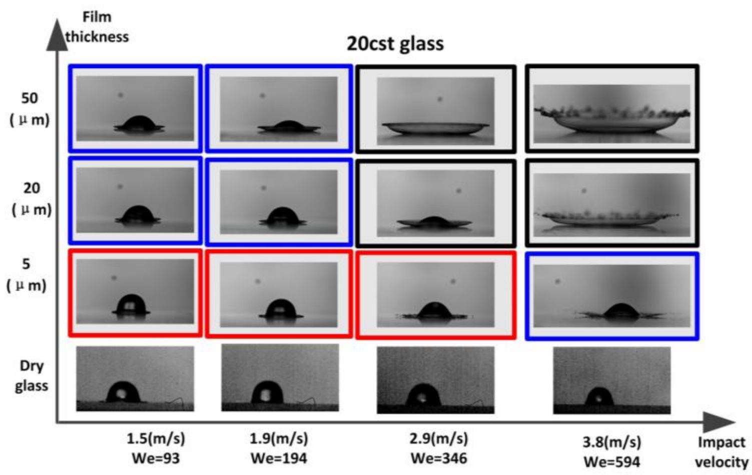

Figure 1 – impact outcome for the spreading phase of water drop impacting a thin oil film of 20 cSt placed on a glass substrate as well as water impact onto a glass surface.