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Interrelation between the Portevin Le-Chatelier effect and necking in AIMg alloys

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1	ACCEPTED MANUSCRIPT Interrelation between the Portevin Le-Chatelier effect and necking in AlMg alloys
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15	ABSTRACT
16	Plastic flow instability caused by the Portevin Le-Chatelier (PLC) effect and its influence on the
17	necking instability were studied in a binary and a precipitation-strengthened AlMg alloy using
18	the digital image correlation (DIC) technique. Coarse-grained structure and two different fine-
19	grained states distinctly distinguished by dislocation density were produced in both alloys using
20	similar routes of thermomechanical processing. The patterns of stress serrations and strain
21	localization observed at different strain rates include virtually all common types of behavior of
22	the PLC effect. Besides, particular spatiotemporal patterns testifying to a concurrency between
23	the propagation and localization of deformation bands are detected at low strain rates. Despite
24	this diversity, the analysis of deformation curves with smoothened-out serrations bears evidence
25	that the onset of necking always corresponds to the geometric Considère condition. Nevertheless,
26	visualization of the evolution of the local strain-rate field using DIC indicates that the two
27	mechanisms of plastic instability are closely interrelated and modify each other's behavior. The
28	neck formation is associated with a progressive immobilization of the PLC bands, ending by the
29	ultimate strain localization. The coexistence of two kinds of instability during necking gives rise
30	to specific spatiotemporal patterns including oscillatory strain localization.
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32 Keywords: Portevin-Le Chatelier effect; microstructures; metallic material; fracture
33 mechanisms; strengthening mechanisms.

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