Pengaruh canai dingin dan temperatur anil terhadap karakteristik paduan cu 28zn 3 2mn hasil pengecoran gravitasi untuk aplikasi selongsong peluru = Effect of cold rolling and annealing temperature on the characteristics of cu 28zn 3 2mn alloy produced by gravity casting for bullet cartridge application

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Abstrak

[Salah satu komponen terpenting pada peluru adalah selongsong yang memuat bubuk mesiu, primer, dan proyektil. Material yang umum digunakan untuk memfabrikasi selongsong peluru adalah cartridge brass (kuningan) yang mengandung 26-32 wt.% Zn. Selongsong peluru diproduksi dengan proses metalurgi yang kontinu, yang terdiri atas pengecoran, pencanaian, dan deep drawing. Dalam proses deep drawing biasanya ditemukan beberapa masalah mayor, seperti keretakan dan perobekan. Untuk meminimalisir masalah tersebut, pengembangan material dengan keuletan yang lebih baik menjadi penting untuk digunakan sebagai selongsong peluru. Mangan digunakan sebagai unsur paduan pada kuningan untuk meningkatkan keuletannya. Pada penelitian ini, paduan Cu-28Zn dengan penambahan 3,2 wt.% Mn difabrikasi dengan pengecoran gravitasi. Untuk menghomogenisasi komposisi kimia, paduan diberi perlakuan panas pada 800 oC selama 2 jam. Kemudian spesimen dicanai dingin dengan deformasi 20, 40, dan 70 % reduksi. Proses anil selanjutnya dilakukan setelah pencanaian dingin sebesar 70 % dengan temperatur 350, 400, dan 450 oC selama 15 menit. Karakteriasi material yang dilakukan pada penelitian ini terdiri dari analisis struktur mikro menggunakan mikroskop optik dan Scanning Electron Microscope (SEM) - Energy Dispersive Spectroscopy (EDS), serta pengujian kekerasan mikro. Hasil penelitian menunjukkan bahwa peningkatan derajat deformasi sebesar 20, 40, dan 70 % menyebabkan butir menjadi semakin pipih dengan L/D ratio masing-masing bernilai sekitar 0,7, 2,2, 7,7, dan 14,1. Selain itu juga terjadi peningkatan nilai kekerasan spesimen, yakni sebesar 56, 127, 145, dan 207 HV secara berurutan. Sementara proses anil setelah canai dingin sebesar 70 % pada temperatur 350, 400, dan 450 oC menyebabkan terjadinya peristiwa stress relieve yang ditandai dengan fenomena recovery, diikuti dengan rekristalisasi (dgrain ~ 7 m), hingga grain growth (dgrain ~ 14 m). Selain itu juga terjadi penurunan nilai kekerasan spesimen, yakni sebesar 204, 131, dan 100 HV secara berurutan. Pengaruh penambahan unsur Mn di dalam paduan cartridge brass adalah meningkatkan nilai kekerasan dan memperlambat laju rekristalisasi, dibutuhkan temperatur anil yang lebih tinggi untuk mencapai rekristalisasi sempurna pada paduan cartridge brass dengan penambahan Mn. ...... One of the most important part of bullet is its cartridge shell which contains gun powder, primer, and projectile altogether. Common material used to fabricate bullet shell is cartridge brass which contains 26-32 wt.% Zn. Cartridge shell is produced by a continuous metallurgical processes, which are casting, rolling, and deep drawing. In deep drawing process, some major problems are typically found, such as cracking and tearing. In order to minimize these problems, it is essential to develop materials with enhanced ductility to be used as cartridge shell. Manganese is used as an alloying element of cartridge brass to increase its ductility. In this research, Cu-28Zn alloy with addition of 3,2 wt.% Mn were fabricated by gravity die casting. To homogenize the chemical composition, the alloy was heated at 800 °C for 2 hours. Afterwards, the specimens were cold-rolled with deformation of 20, 40, and 70 %. Subsequent annealing process after 70 % cold-rolled with

temperature of 350, 400, and 450 oC for 15 minutes was carried out. Material characterizations consisted of microstructure analysis using optical microscope and Scanning Electron Microscope (SEM) - Energy Dispersive Spectroscopy (EDS), and microvickers hardness testing. The result showed that higher degree of deformation of 20, 40, and 70 % led to more elongated grains with L/D ratio of 0.7, 2.2, 7.7, and 14.1, respectively. Moreover, the hardness of material increased with the increase in the level of deformation, with the values of 56.1, 126.6, 144.6, and 206.7 HV, respectively. Meanwhile, annealing at the temperatures of 350, 400, and 450 oC to specimens with prior deformation of 70 %, resulted in recovery and stress relieve, followed by recrystallization (dgrain ~ 7 m), and finally grain growth (dgrain ~ 14 m). Furthermore, the hardness of material decreased with the increase in level of annealing temperature, with the values of 204, 131, and 100 HV, respectively. The roles of Mn in the cartridge brass is to increase the hardness and to slower the recrystallization rate. In general, addition of Mn in cartridge brass increased the annealing temperatures needed to achieve full recrystallization.;One of the most important part of bullet is its cartridge shell which contains gun powder, primer, and projectile altogether. Common material used to fabricate bullet shell is cartridge brass which contains 26-32 wt.% Zn. Cartridge shell is produced by a continuous metallurgical processes, which are casting, rolling, and deep drawing. In deep drawing process, some major problems are typically found, such as cracking and tearing. In order to minimize these problems, it is essential to develop materials with enhanced ductility to be used as cartridge shell. Manganese is used as an alloying element of cartridge brass to increase its ductility. In this research, Cu-28Zn alloy with addition of 3,2 wt.% Mn were fabricated by gravity die casting. To homogenize the chemical composition, the alloy was heated at 800 °C for 2 hours. Afterwards, the specimens were cold-rolled with deformation of 20, 40, and 70 %. Subsequent annealing process after 70 % cold-rolled with temperature of 350, 400, and 450 oC for 15 minutes was carried out. Material characterizations consisted of microstructure analysis using optical microscope and Scanning Electron Microscope (SEM) - Energy Dispersive Spectroscopy (EDS), and microvickers hardness testing. The result showed that higher degree of deformation of 20, 40, and 70 % led to more elongated grains with L/D ratio of 0.7, 2.2, 7.7, and 14.1, respectively. Moreover, the hardness of material increased with the increase in the level of deformation, with the values of 56.1, 126.6, 144.6, and 206.7 HV, respectively. Meanwhile, annealing at the temperatures of 350, 400, and 450 oC to specimens with prior deformation of 70 %, resulted in recovery and stress relieve, followed by recrystallization (dgrain ~ 7 m), and finally grain growth (dgrain ~ 14 m). Furthermore, the hardness of material decreased with the increase in level of annealing temperature, with the values of 204, 131, and 100 HV, respectively. The roles of Mn in the cartridge brass is to increase the hardness and to slower the recrystallization rate. In general, addition of Mn in cartridge brass increased the annealing temperatures needed to achieve full recrystallization., One of the most important part of bullet is its cartridge shell which contains gun powder, primer, and projectile altogether. Common material used to fabricate bullet shell is cartridge brass which contains 26-32 wt.% Zn. Cartridge shell is produced by a continuous metallurgical processes, which are casting, rolling, and deep drawing. In deep drawing process, some major problems are typically found, such as cracking and tearing. In order to minimize these problems, it is essential to develop materials with enhanced ductility to be used as cartridge shell. Manganese is used as an alloying element of cartridge brass to increase its ductility.

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