

**Разработка технологий гибридной сварки CO<sub>2</sub>-лазер+GMAW  
бейнитных сталей с ультранизким содержанием углерода**

05.02.10— ,

õC -

ö.

( ).

: ,  
,  
:  
,  
,  
,  
,

: ã -

« »ö

« »\_\_\_\_\_ 2011 . \_\_\_\_\_  
.212.229.26 ã C -

ö

:

195251, , . C - , . , . 29,  
1, .41.

õC -

ö

« »\_\_\_\_\_ 2011 .

,  
, . .

### Общая характеристика работы

#### *Актуальность работы*

, ,  
 , ( )  
 .  
 + - , ,  
 + ,  
 .  
 +  
 ( ),  
 ,  
 +GMAW , ,  
 . ,

#### *Цель работы*

CO<sub>2</sub>- +MIG, ,

#### *Основные задачи*

+MIG , .

, ,  
 , 12  
 . : , ,  
 , ,  
 CO<sub>2</sub>- +MIG MIG,  
 ,  
 , ,

**Научная новизна**

1)

+MIG

+MIG

2)

+MIG,

3)

**Практическая значимость****Апробация работы**

“

”

13-

14-

(08.2008 . 08.2009 .) ,

“

”

(05.2010 .) ,

“

”

(10.

2009 .).

**Публикации**

6

**Структура и объем работы**

98

102

, 13

, 95

**Содержание работы****Во введении****Первая глава**

+

80- 20 .

0.05%,

( TMCP RPC) -

C, S, P,

C

V, Ti, Nb, ε -Cu

+GMAW

1985 .

S. Nagata .

+CO<sub>2</sub>-

YAG-

+GMAW

+GMAW

(12 ).

(D<sub>LA</sub>),

(d),

( ),

( ),

“ +

”

”

“ +

GMAW -

Во второй главе

ULCB700 ( -0.038%)

BGH60 (ø1.2 ).

MIG+CO<sub>2</sub>-

3

,

(SEM ).

**В третьей главе**

+GMAW

( ).

$D_{LA}$ ,  $d$ ,

(Ar, He CO<sub>2</sub>)

2000

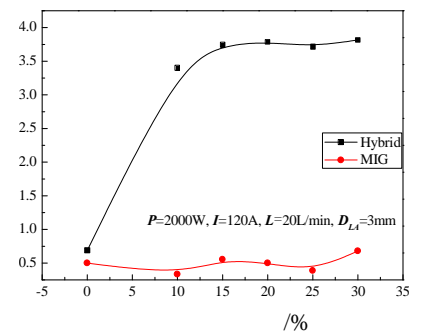
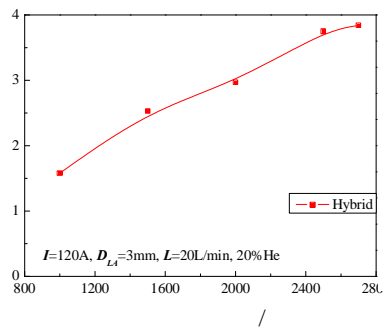
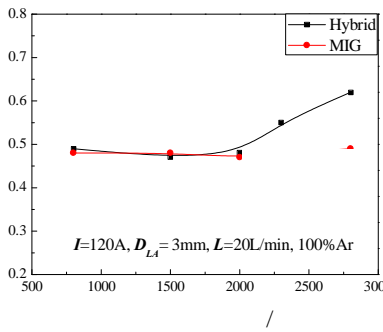
Ar+He

15% He

20% He -  
35% He

He

Ar,



Ar + He

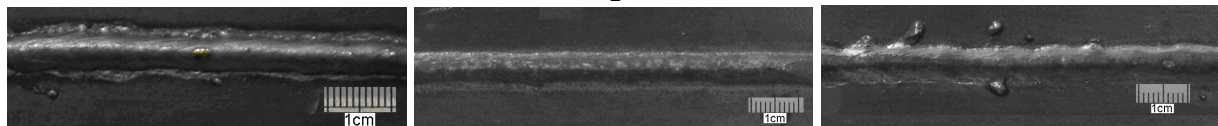
CO<sub>2</sub> ( . 2).

CO<sub>2</sub>,

CO<sub>2</sub>

CO<sub>2</sub>

163%.



a) 80% Ar+20% He

b) 79% Ar+20% He+1% CO<sub>2</sub>

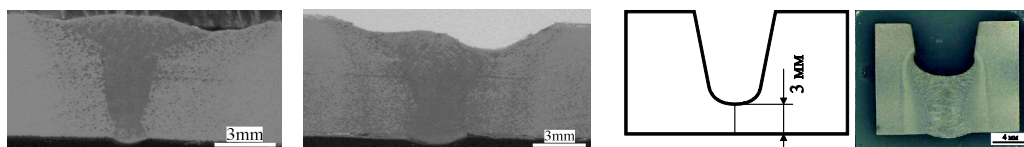
c) 75% Ar+20% He+5% CO<sub>2</sub>

. 2

CO<sub>2</sub>

( . 3).

+MIG



)

1 30°;

b)

60°

)

U-

.3

V-

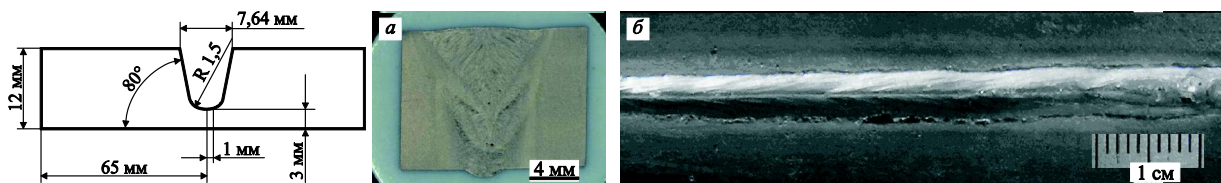
(a-b) U-

( )

( d = 6 1 )

- : 1)
- ; 2)
- ; 3)

.4.



. 4

U-

12

d

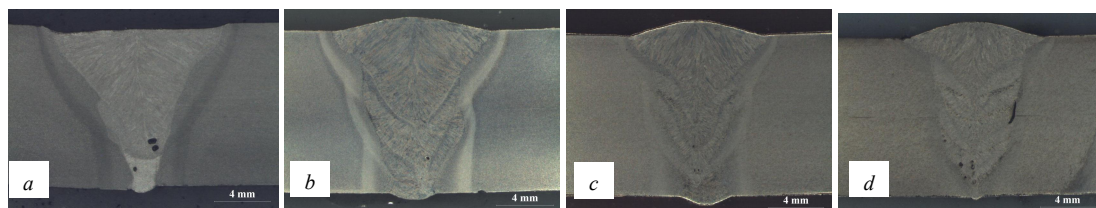
( d -1 ); d = -1 í +1



( . 5),

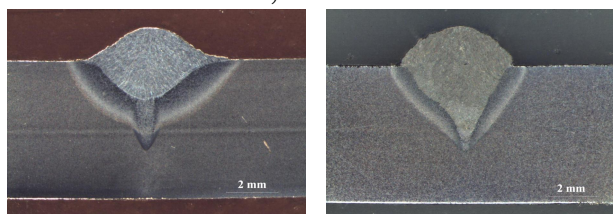
12

3- 3



. 5 (a), 3- (b), 4- (c) 5- (d)

. 6



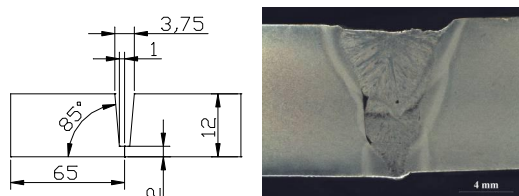
a) - b) -

. 6

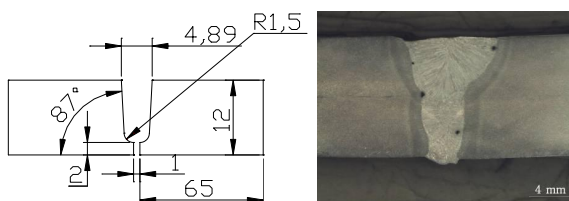
(P=2000 , I=120 A, L=20 / , 25%He)

**В четвёртой главе**

CO<sub>2</sub>- +GMAW



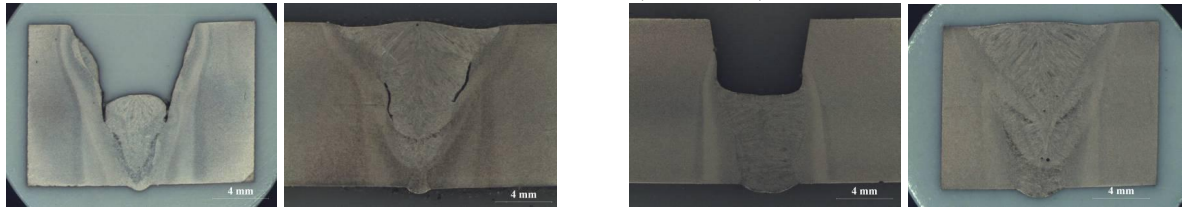
a)



b)

. 7

( ' .7-8).



a) 1- .8

b) 1-

( .9a-b).

( $\varphi$ ),

( .9a).

( .9 ).

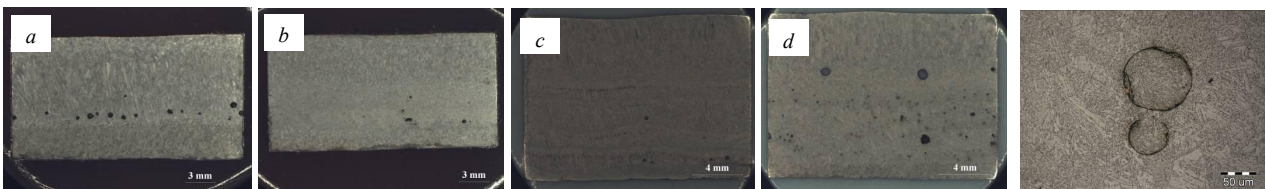


.9

(b- 300), - : a b 50° .

0°

( .10).



a- .10 2 , b- 3 , c- 4 d- 5 (2,5 ) .11 300

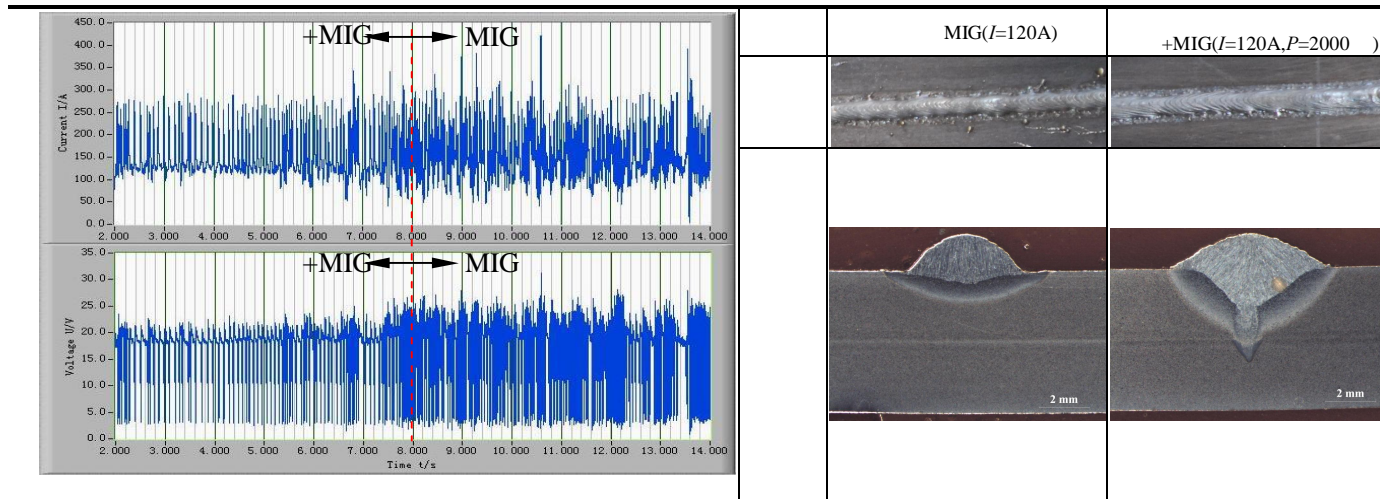
( .11).

220062800 ; 4; ; 0,8-1 / ; ; 160-220 A;  
 24-30 ; ; 79% Ar+20% He+1% CO<sub>2</sub>; ; 30  
 / ; ; D = 3 .

**Глава 5**

CO<sub>2</sub>

+MIG



.12

.12

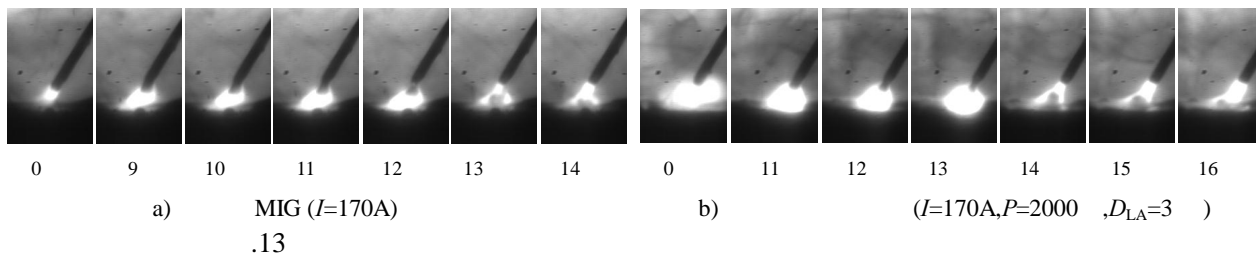
MIG

MIG.

400 ,  
( )

30 ,

( .13),



.13

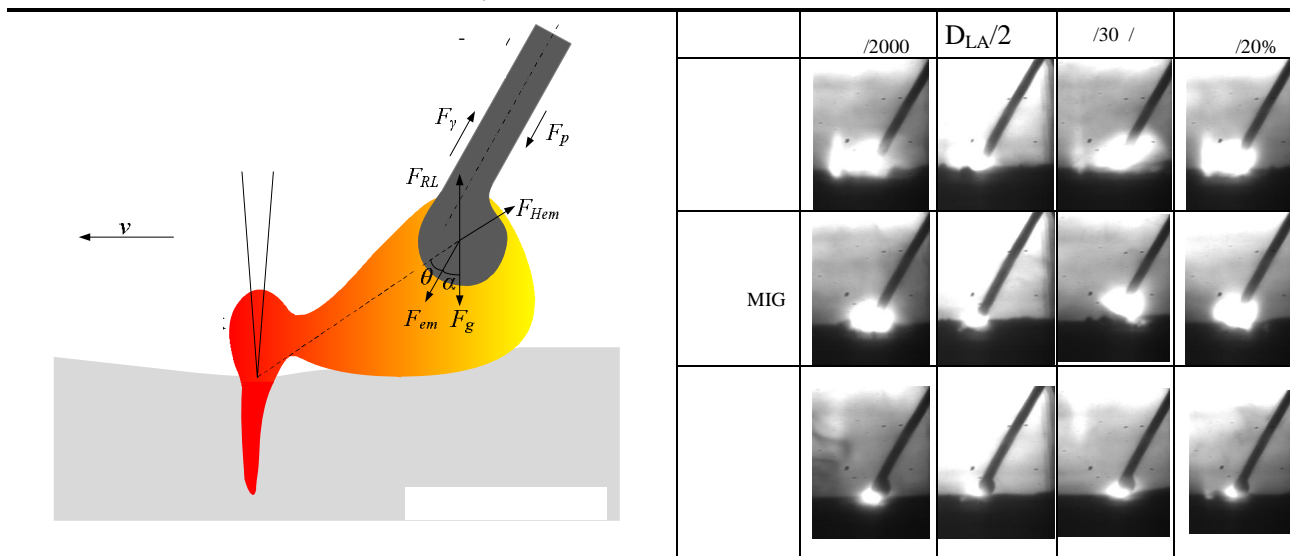
MIG

( .14).

$F_{Hem}$

$F_{RL}$

MIG



.14

( $F_p-$

;  $F_{em}-$

;  $F_g-$

;  $F_y-$

;  $F_{RL}-$

;  $F_{Hem}-$

.)

6. В шестой главе

$CO_2-$  +MIG.

MIG,

( )

.15

MIG -

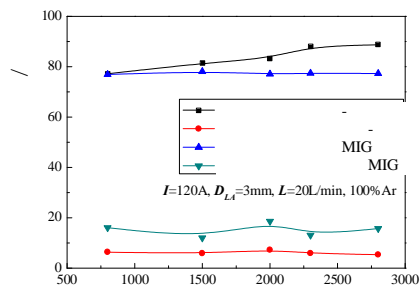
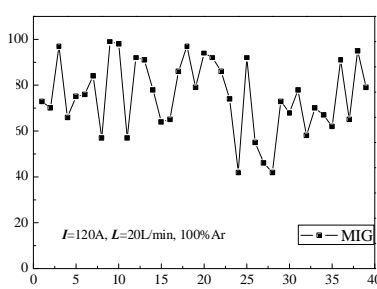
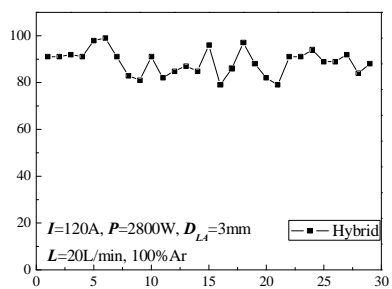
40-100

80-100 ,

( . 15)

MIG.

MIG ( . 16) .



.15

.17

(T1),

. A

$F_{Hem}$ ,

$D_{LA}$   
 $D_{LA}$   $F_{RL}$

$F_{Hem}$

$F_{Hem}$

$D_{LA}$  ( .18).

( .19),

$d$ ,

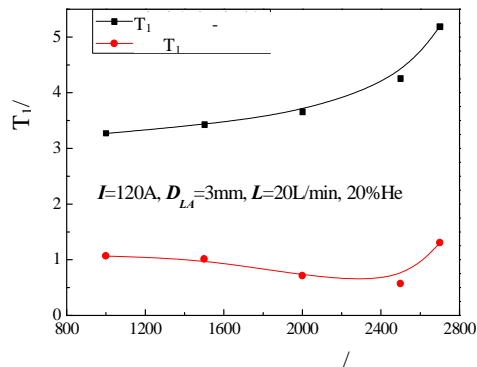
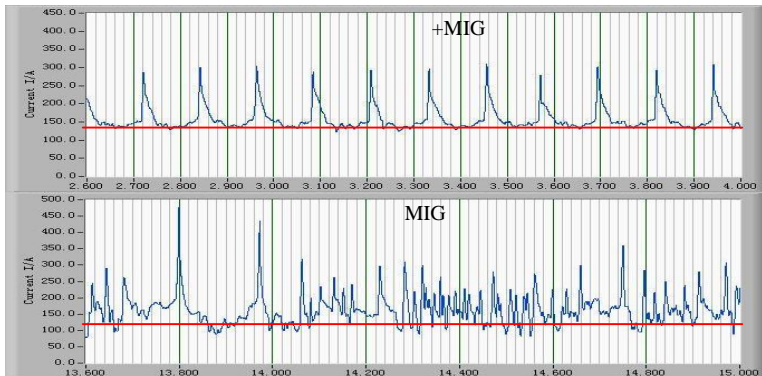
$d = 0$ .

$d = 0$

$d$ .

$d = 0$

$d$ .

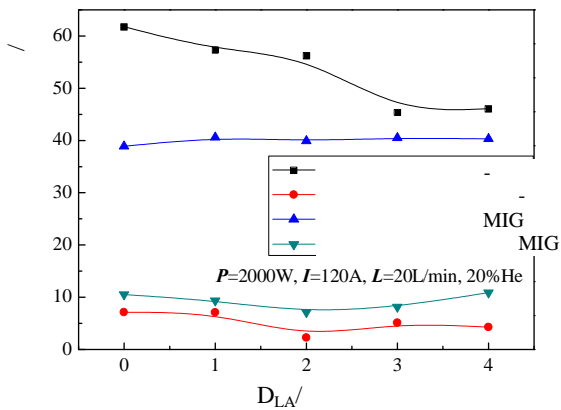


.16

120

.17

T1



Различн ый d			
Состояни е дуги и капли			
Сечение шва			

.18

$D_{LA}$

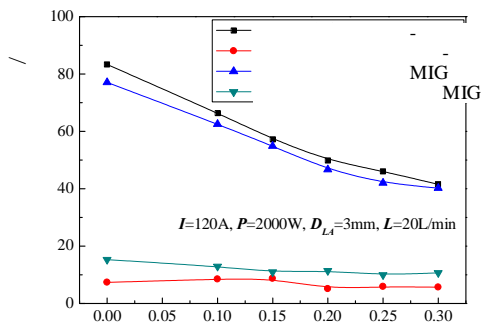
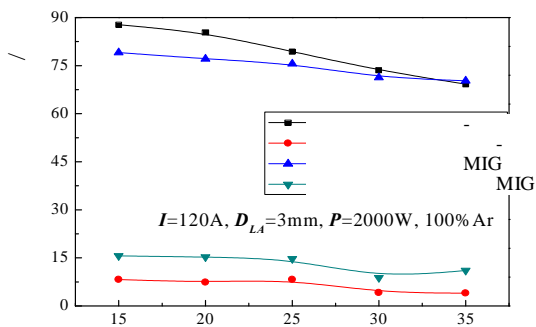
.19

$d$ .

$D_{LA} = 2$

$D_{LA}$

$d = 0$



.20

.21

MIG

(.20),

.21  
He


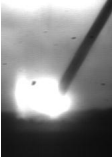
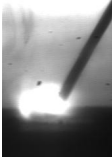
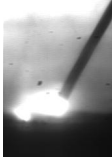
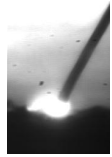
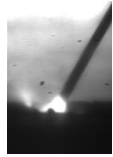

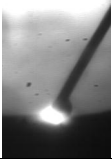

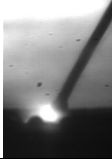

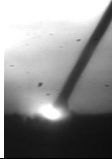


MIG

He 30%

(.22),

Ar+ He

Ar.

He	0%He	10%He	15%He	20%He	25%He	30%He
						
						

.22

He

Ar+ He

**В седьмой главе**

+GMAW.

23)

+ +

, ( GHAZ)

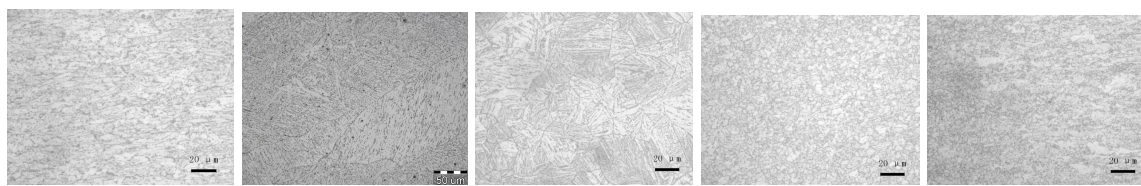
GHAZ

270 - 330 HV.

+GMAW,

93%

829.4 M a



GHAZ

FGHAZ

ICHAZ  
(300x)

. 23

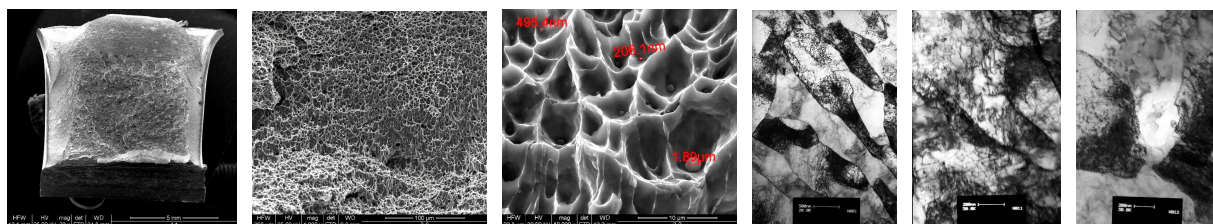
( . 24 d, e, f)

( )

SEM ( . 24 c).  
Ti, Mn Al,

(129)

- 40°



a)

b)

c)

d)

f)

. 24

SEM

: a - 2.1 , b ó 1000 , c ó 10000 ;

: d - BF 20k , - BF 50k , f - BF 38k.

**Общие выводы**

1.

79%Ar+20%He+1%CO2

3

2.

12

3.

4.

MIG.

5. С

6.

$$D_{LA} \\ d = 0$$
 $D_{LA} = 2$ 

7.

8.

+GMAW,

129

93%

- 40°

**Научные результаты диссертации отражены в следующих работах**

1.

/ // . 2008. №1.  
- . 52-61. ( ).

2.

2- +MIG /

// . 2008. № 4. - . 34-39.  
( $D_{LA}$ )

3.

2- +MIG/ ,

[ .]. // . 14- ÷  
ö (08. 2009 .). ó : - , 2009. ó .III. ó .89-94.

4.

2- +MIG/ //  
. 2009. №3.- . 84-88.

5.

2- +MIG ULCB700/ //  
2011. . 66. №2. - . 90-97. ( ).

6.

+MIG/ // . 2011.  
. 66. №2. - . 98-103.( ).